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The Pennsylvania Electrification

IT is to be expected that any innovation will be tried first either under compulsion or where its advantages are most manifest. Railway electrification came in the United States first as a solution of difficult terminal problems where smokeless operation was essential. Then came the application to trunk-line divisions with heavy gradients. Following the same rule, the determination to electrify certain branches of the Pennsylvania Railroad in the Philadelphia territory rested upon a special advantage, and not upon the economy under entirely normal conditions. As was well set forth in the last issue of the Engineering Record, page 590, increased capacity in the Broad Street Station was imperative. The alternatives were electrification and costly alteration of the terminal. The latter would mean a large addition to capital cost, and represent an investment necessarily unproductive. The adoption of electrification, on the other hand, on account of saving in operating costs, is in part, at least, self-sustaining. The saving will be sufficient, when compared with the cost of operation under steam, to pay interest on the additional investment. One is tempted to speculate upon the period which will intervene before the entire Philadelphia district of the Pennsylvania is electrified, and then, letting loose a bit on one's imagination, to ask whether, when this electrification is accomplished, electrical operation between Philadelphia and New York is not a logical and quite an immediate step.

Artistic City Bridges

ENCOURAGING are the signs that city departments are giving more consideration than formerly to the architectural treatment of bridges and other civic structures. Some cities, fortunately, have long given adequate study to their bridges, and an account of some recent work in Philadelphia, on page 598 of the last issue, not only gives typical features of several bridges but shows that the Bureau of Surveys of that city is still improving on the practice which as many as 10 years ago made its concrete bridges notable for general appearance and finish. It is significant that there is employed in the bridge division an "architectural bridge draftsman" who devotes his whole time to making comparative studies of possible architectural treatments of structures. Not only are the structures themselves designed to be pleasing, but the surroundings whenever possible are given consideration. A small expenditure for the sodding of embankments, and the planting of trees and shrubs, gives a finishing touch that sets off the structural work. It has been found in Philadelphia that the public appreciation of these structures is keen. It would not be possible to impose on any group of Philadelphians an ugly bridge of the old type, because they have, during some 10 years, been educated to higher standards by actual examples. The appreciation of the working classes is just as keen, too, as that found in wealthier sections. The thought that "anything" will do for a mill district and that handsome bridges are only for boulevards has, therefore, been rejected. Pleasing treatment adds but little to the cost of a structure. What it adds to the tone of a neighborhood—as an inspiration for better-kept yards and homes—cannot be computed, but the result unquestionably is very large.

Realizing on Engineering Assets

IT WOULD seem that the best advertising a railroad company can do is to exploit those of its engineering achievements and precautions which make for the safety and comfort of its passengers. Railroad publicity, however, has been in the hands of those who love florid language, suitable only for lavishing upon the road's scenic wonders and on the elaborate equipment of its limited trains. With the "safety first" movement vigorous, progressive roads can make much capital out of their engineering and management policies and achievements. The Southern Pacific is vigorously advertising its success in winning the Harriman safety medal, while the Pennsylvania is using the menu cards in its diners for little preachments on its practice for insuring safe drinking water on trains, its policy with regard to steel cars, and the construction and maintenance standards which produce its wonderful roadbed and track. Just now the Lackawanna is telling the East about the wonders of its new cut-off and of the giant Tunkhannock viaduct. With pardonable enthusiasm it characterizes the structure as the "Ninth Wonder of the World," thus catching the fleeting attention of a busy public. Moreover its revised time-tables, made necessary by the shortened schedule over the new line, devotes three pages to pictures and a description of the engineering marvels of the new route. Even the most careless reader cannot but feel that here, with massive structure, wide cuts and no grade-crossings, there must be a safer, better railroad. Without doubt engineers are partly responsible for the lack of appreciation on the part of railroad publicity departments of the engineering advantages of their lines. The publicity man is not able to grasp engineering facts in engineering language; they must be translated for him, and their importance made striking by means of comparison with common objects and experiences. A little effort on the part of engineers in this direction would undoubtedly redound to the benefit of their systems in an advertising way and would also help to emphasize the importance of the engineer's work.

Coroner's Jury Exonerated

THE jury which investigated the collapse of subway decking on Seventh Avenue in New York City should not be confused with the average coroner's jury. The Engineering Record has been reliably informed that its editorial comment of Nov. 6 on the findings of this jury was at fault in suggesting something of the kind. As a matter of fact, hastily as the jury was assembled, it was drawn from a panel including many of the best-known engineers in the city, more than one of whom served (with contractors, architects, and professional men) on the jury. It is interesting to note that the strong impression was made on the jury by the evidence, according to one of these engineers, that the street-railway car which fell into the cut, causing most of the deaths, had no business where it was at the time of the blast. The impression created by the evidence was that this car had overrun a red flag in an attempt to get by before the blast was fired, and had been traveling at too high a speed in approaching the block. Rather than indict the motorman or the blasting foreman for what the jurymen felt to be a public fault, allowed constantly to pass unchallenged by the city administration, the verdict recommended that in future traffic be barred from temporary street decking when blasts are fired. It should be said in justice to the jury that it did not censure the fire department for failing to enforce the use of blasting mats, but for failure of its inspectors to specify, as is provided by ordinance, the maximum quantity of dynamite per ton of rock which would be safe in the rock being excavated at the scene of the accident. The view in which the jurors finally concurred held that had such a maximum limit been set, it would have been proper to indict the blasting foreman. This man testified that each hole was loaded with two and one-half times the quantity of dynamite that he had used in firing previous rounds in the same heading. Even this testimony failed to account for all of the twenty-five sticks which were taken from the powder house on the morning of Sept. 22. Why the holes in this particular round were loaded so heavily the evidence did not clearly disclose. The jury concluded, however, that the law empowered the inspectors of the fire department to fix a safe upper limit for the proportion of dynamite to rock in the various subway cuts. Therefore, since, according to the evidence, the inspectors had not done this, it was held that they were at fault and they were censured accordingly.

Two Road Meetings or One

DISCUSSION of the decision of the American Road Builders' Association to hold a convention next January or February, which appears elsewhere in these columns, naturally prompts the inquiry whether one or two road congresses will be held in future. As those interested in highway matters know, the Engineering Record has consistently urged that there be only one national road congress each year. That policy, if adopted, would mean a considerable saving for engineers, highway departments and manufacturers. Moreover, with the rapid increase of local highway meetings the educational work is being well handled, and more than one national meeting is not called for. Then, too, one large meeting would be sufficient for the exchange of views between experts. From every angle a single national meeting is desirable and sufficient.

Practically, however, the attainment of any permanent agreement between the American Highway Association and the American Road Builders' Association seems to be impossible. Their joint effort at Oakland was discouraging. The meeting was only a shadow of what a national highway congress should be. Antagonistic personalities in the two associations, the desire of those in the management of both to wield an influence in the highway movement, and the lack of "backbone" on the part of both engineers and manufacturers, who time and again have declared that they would only attend one meeting, make any effective and lasting unification impossible.

While the Engineering Record still holds, and will maintain, that a single national meeting (with many local meetings by State and county organizations) is ample for all needs, it will cease for the practical reasons cited to advocate the policy. Contemplating, however, the reasons for abandoning the policy one cannot suppress a cynical and critical feeling toward those whose narrowness has prevented, and still prevents, the adoption of the better plan.

The Spirit of the Agreement

ANNOUNCEMENT has been made that the American Road Builders' Association will hold a convention in January or February next, either at Cleveland or Pittsburgh. This action, it seems to the Engineering Record, is a violation of the spirit of the agreement made between the Road Builders' Association and the American Highway Association when the Pan-American Road Congress was organized. The agreement was that the individual conventions of these two associations were to be abandoned. It appears that there was no written agreement as to just which conventions should not be held. Apparently, therefore, there will be wide diversity of opinion regarding the action of the Road Builders' Association. Certainly, however, it was the belief of this journal that the conventions of what might be called the 1915-16 convention season were to be abandoned. It is inconceivable that the American Highway Association would have agreed to the Oakland congress plan had it suspected that the abandonment of the Road Builders' December convention was to be followed by a January or February meeting.

The Road Builders contend that for some years they have been considering the advisability of transferring their convention from December to January or February, arguing that in the dead of winter engineers and contractors are sure to be free from field duties and will thus be able to attend the meeting. Had they determined not to make the change until the season of 1916-17, an interval of 17 months would have elapsed between the Pan-American Road Congress at Oakland and their 1917 convention. Such an interval, manifestly, was undesirable, and the directors of the association therefore determined to take advantage of this prospective long interval to hold a meeting in February of next year. Without a doubt the directors are sincere in their belief that their action is not a violation of the agreement between the two associations.

In this view, however, the Engineering Record cannot share. While it appreciates the advantages to the Road Builders' Association of the January or February meeting, it holds that it was unfortunate to make the change at the present time when the association was bound by relations with the American Highway Association. To say the least, the move has been an unfortunate one. Technically the Road Builders (in the absence of written documents) may be entirely within their rights. It is hard, however, to square the abandonment of a December convention and the holding of a February meeting with the spirit of the agreement with the Highway Association.

Philadelphia Engineers Know How

SIXTEEN HUNDRED new members in $4\frac{1}{2}$ days—such is the record that the Engineers' Club of Philadelphia has set up for the emulation and inspiration of engineering clubs and societies throughout the country. Starting on Monday morning, Nov. 8, with 551 members, the membership rose by noon of Friday, Nov. 12, to 2127, making the Philadelphia organization the largest local body of engineers in the United States, exceeding even the New York Engineers' Club. Since the close of the campaign over 200 additional applications have been secured, bringing the total to nearly 2350 members.

The story of organization, team-work and enthusiasm is partially told in the news pages of this issue. Little is said, though, about the sacrifices that must have been made by team captains and their men, for only individual recital of methods could convey an adequate idea of the energy required to attain and surpass the predetermined mark—1000 new members. The imagination and experience of the reader must be left to visualize the work that was done in those $4\frac{1}{2}$ strenuous days.

One cannot suppress a feeling of pride that an engineering organization has had the vision, the courage and the ability to attempt such a campaign. Engineering associations are accustomed to proceed along conservative lines. Campaigns and advertising are taboo. They are believed to be out of harmony with the dignity of the organization. The profession at large, therefore, owes a debt of gratitude to the Philadelphia club for daring to depart from the beaten path and take the chance of inviting censure and criticism. Be it recorded, though, that despite the whirlwind character of the campaign, it did not clash with the dignity and standing of the club. No adverse criticism has been deserved and none has come. Instead, there is a quiet pride of accomplishment, a new sense of the possibilities of the organization, a closer fellowship on account of the intimate contact—and contest—between the campaigners. The club has demonstrated that publicity methods can be used without detriment—aye, with great gain—to the organization.

The club members are not unmindful, too, of the obligations which the larger membership entails. The club, fortunately, is not content, as are some engineers' clubs, to be merely a social organization, furnishing a place for the members to entertain their guests and to be entertained. It believes it has a mission to further the interests of the profession and such civic interests as are of an engineering character. Its participation last year in the discussion on the desirability of licensing engineers in Pennsylvania is an example of the work it aims to do. With the ability and energy displayed in the campaign and with the large addition to membership, one may confidently expect the club to initiate and successfully carry through plans in every way worthy of its position as the largest engineering club in the country. It was apparent at the closing luncheon that while there was pride in the total membership resulting from the campaign, numbers were considered not as an end but as a means for increasing the club's ability to serve the profession and the community.

One of the very noticeable features of the campaign, and one that deserves emulation generally, was the effort made to secure the applications of the most prominent engineers in Philadelphia, particularly of those who have been graduated into executive work and on this account have largely lost their touch with engineers and with things engineering. In this effort the campaigners were singularly successful. One can safely predict that if the club is able to secure the active work of these men, whose advancement is an assurance of their broader vision and great ability, its possibilities for accomplishment will be immeasurably increased.

Without doubt the Philadelphia club's campaign methods will be closely studied by engineering societies throughout the country. Much can be learned from its efforts. Aside from the very apparent advantage of larger membership, no small value should be placed upon the greater confidence which the result has given the members and the closer fellowship resulting from the work. The publicity in the daily press, too, has undoubtedly given the club a wider influence.

Other organizations may feel that the time for a similar effort is not ripe. In one particular, however, local clubs generally can at once follow the lead of the Philadelphia organization—in bringing about an affiliation between the local branches of the various national engineering societies. In fact, it was this affiliation between the local associations of members of the national bodies which led logically to this greater step of an enlarged and more powerful Engineers' Club. Some other cities have been working on the affiliation plan. St. Louis has progressed far, and without a doubt the possibilities elsewhere, while necessarily smaller than in the third city of the country, are still very large.

The Engineers' Club of Philadelphia is to be heartily congratulated on the success of its campaign, and even more so on the possession of a membership undaunted by a big idea.

Freedom to Choose Customers

THERE is a lot of comfort for many manufacturers in the decision of the United States Court of Appeals for the Second Circuit in the cream of wheat case. This is the first case of its kind that has been decided since the enactment of the Clayton law, and those who assumed that that law would operate to destroy all liberty in the choosing of customers, although purporting to grant this right, may now take heart. The case of the Great Atlantic & Pacific Tea Company vs. the Cream of Wheat Company was dismissed by Judge Hough of the United States District Court for the Southern District of New York last July. The tea company complained that the refusal to supply it with cream of wheat was an illegal discrimination, based upon objection to the act of the tea company in selling cream of wheat below the advertised price. Judge Hough's decision was so sweepingly and emphatically adverse to this contention that cautious counsel advised their clients not to assume that it would be upheld on appeal. Judge Hough's decision from the manufacturer's point of view was apparently too good to be true.

Judge Hough has now not only been upheld, but the Court of Appeals seems to have been infected with some of the spirit that characterized the decision below. Judge Lacombe, for example, remarks in his opinion: "We had supposed that it was elementary law that a trader could buy from whom he pleased and that his selection of seller and buyer was wholly his own concern. It is part of a man's civil rights that he is at liberty to refuse business relations with any person whomsoever, whether the refusal rests upon reason or is the result of whim, caprice, prejudice or malice."

That seems plain enough, and after reading it the layman may wonder what has been bothering the manufacturer with respect to his liberty to sell or to refuse to sell his products as he might see fit. Whim, caprice, prejudice and malice, collectively, seem to be fairly inclusive of the motives—now legally approved—that might induce a producer to refuse to sell to a given customer. But it must not be forgotten that the court has not said that a refusal to sell is justified if the purpose or result of such refusal is to create unreasonable monopoly and restraint of trade. The two decisions are so worded that this important fact may be overlooked. We may act on caprice or malice, but restraint of trade is still forbidden.

It is an unavoidable consequence of the rulings in the cream of wheat case that the burden of proof to show an improper motive in the choosing of customers will hereafter lie heavily upon the plaintiff or prosecution. Under a reasonable application of Judge Hough's and Judge Lacombe's decisions, it would seem that every assumption is in favor of the defendant and that it will devolve on complainants to prove that objectionable actions are not due to caprice but are plainly dictated by a desire to restrain trade. For some years we have had—with the notable exception of the announcement of the rule-of-reason doctrine—a long line of decisions the effect of which was to sharpen the teeth of our anti-trust laws and almost to create panic among those who wanted to obey the law, whatever it was, and at the same time conduct their business successfully. The cream of wheat decision represents a decided reaction from strict construction of anti-monopoly laws, at least so far as the important matter of choosing customers is concerned.

Engineering Problems of the Submarine

THE European war has directed upon the submarine, owing to a few sensational exploits, a degree of attention which is perhaps not altogether its due. It is not known accurately how large a number of submarines Germany had at the beginning of the war, nor indeed how many have been added, but neither number is a very great one, and there are evidences that the total has been greatly reduced by an active campaign of trapping and sniping.

To secure the merit of invisibility when prowling about, the submarine sacrifices speed to a degree which is a very serious handicap. The two weak points in general design are, therefore, the power plant for operating on the surface and the electrical equipment now necessary when working submerged. The ordinary storage battery in almost universal use is put at a disadvantage by its weight, its fuming and the added unpleasant results of even a very small leak if sea water reaches the battery solution. When working on the surface it seems to be difficult to extract from oil engines of practicable size the requisite amount of power for high speed. In at least one of the early French submarines the lead battery was replaced by an alkaline storage battery, and the substitution of the Edison battery in some of our own submarines now building may tend to lessen risks and greater possibility of prolonged submersion.

As to primary motive power, there have been many recent suggestions of using steam engines with flash boilers or their like, fired by oil, in the hope of getting greater effective power. The gasoline engine which could be made so enormously effective seems barred by the extreme danger of leak in gasoline tanks when the boat is running submerged.

The tendency seems to be toward the building of bigger and bigger submarines with more speed and greater cruising radius, with the possible differentiation of a coast-defense type of relatively small size and power. Whether this last stands much chance of practical usefulness may be considered somewhat doubtful. Experience seems to show that purely defensive methods must be considered of dubious utility. The offensive-defensive seems to have the advantage both on sea and land. And in fact one of the greatest dangers of the submarine, so far as our own country is concerned, is that the somewhat sensational German operations may lead us to put unjustified confidence in submarine craft, not as auxiliaries for special purposes, but as a general defense, leading to the development of a shipless navy which would fail even as a defense in case proper means of dealing with the submarine are developed during the present war.

All the indications point to the probability of an effective reply to submarine warfare, thorough enough to destroy the value of the submarine for coast defense. In spite of the destruction of numerous trawlers and freighters, with now and then a liner, the precautions taken by Great Britain against submarine operations have been sufficient to avoid even a single casualty among the great fleets of transports carrying men and war materials to the coast of France. It is questionable whether when the war ends the new weapon will be regarded as practically more efficient than some of the old ones.

If the United States chooses to build a considerable fleet of submarines they will unquestionably not be without their use, but if it builds them at the expense of an efficient sea-going navy this is likely to prove money wasted. The ingenuity of the engineer is being more actively applied to means of destroying submarines than to improvements in them, and at present apparently with greater results. The under-water telephone, for example, by which one can hear the machinery of the submarine at a distance of several miles and locate its approximate direction and distance, is likely to be a formidable weapon in hunting these unseen prowlers, and very likely has already been of material assistance. Not less important is the giant aeroplane with ample bomb-carrying capacity and power to keep the seas for long voyages. Between these and the fast-scouting boats and nets, the work of the submarine is already beset with great difficulties, so that while recognizing to the fullest the value of such craft under certain circumstances it behooves one to go very cautiously before putting great faith in the submarine defense alone as a security against invaders from the sea.

Philadelphia Valuation Conference—Some Editorial Views

A Far-Reaching Conference

A MOMENTOUS conference on valuation was held by the Utilities Bureau in Philadelphia last week. An account of it will be found in the news section of this issue. Commissioners, lawyers, economists and engineers were drawn from all parts of the United States, and doctrines were propounded which, if they could be proved to be correct, would have a tremendous effect on public utilities of all sorts. The Engineering Record is obliged to disagree with many of these doctrines. It feels that the presentation of the many problems involved was one-sided and may have done great harm. It feels further that the radical views revealed are an indication that we have not yet got down to fundamentals; that these fundamentals are not, as many hold, matters of law and its interpretation, but are questions of pure ethics and public morality.

A Belated Announcement

IT SEEMS unfortunate that the opening remarks of Mr. Cooke, acting director of the bureau, setting forth the purpose of the conference, did not appear in the advance program. A conference suggests opportunity for equal presentation of all sides of the subject, and the great preponderance of announced speakers from the consumers' viewpoint was the only intimation to be derived from the program that one side only was to be featured. In his opening remarks Mr. Cooke in a few words made it plain that the bureau thought the utilities amply able to handle their side of the case, and that this conference was called to develop the consumers' side. Such being the case the program could well have so stated.

Who Are the Public?

THIS JOURNAL uses the term consumers advisedly. In the conference they were habitually referred to as the public. It is here submitted that the users of utilities are only part of the public, or rather, that the public includes other classes than users. The Pennsylvania Railroad has 90,000 stockholders—a public much smaller than that of its users, but larger than the consuming public of many a gas or water utility. Besides the individuals, banks and insurance companies have vast sums invested in utility securities. The commissions and bureaus are not representing the whole public so long as they segregate the investing public and treat it, through the managers of the utilities, as a foe of the whole people, to be opposed as a public menace at every turn.

What Is Rate Making?

RATE MAKING was a favorite phrase at the meeting. Always it was given the same significance—rate cutting. Distress was more than once voiced that the rate-makers would have to remain idle for a period of years because conditions would not warrant any further reductions. Not once was it suggested that they might busy themselves raising rates as conditions might require. The Engineering Record repeats that if the commissions are fairly to represent the whole public, including the investing public, it must regard the rate as something capable of movement either up or down.

The Agency Theory

JUDGE HELM of Kansas, Professor Bauer of Cornell and others pictured the agency theory in bold relief. The utilities, they say, are public property entirely; the book owners are but the managers, or, to be more accurate, the foremen, the real management being vested in the public. Government ownership, according to that view, must already be here, but the Government is saved from putting up the purchase price by forcing the stockholders to loan it on doubtful security. The stockholders are limited to a "fair return," the public taking the rest—but the earning of this fair return is put squarely up to the management. If the theory could be sustained, there would be no further argument for reproduction cost; neither unearned increment, nor donated land, nor franchise values, nor anything else not actually paid for, would be entitled to any income. The Engineering Record does not believe that the theory is correct.

Law and Justice

INSTANTLY comes a chorus of exclamations that this is not a matter of opinion, but of law, established long ago in the Munn case in 1876. The Engineering Record is not a law analyst. It does not believe, however, that all of the points claimed have been positively settled. It has perceived, as Mr. Burch has, that whatever the question on the general subject, plenty of decisions are cited to support either side. It has noted with Mr. Knowles that court decisions change with the times. Beyond all that, if the agency theory is in accord with law the Engineering Record believes the law itself must ultimately be changed in the interests of real justice.

What Is Regulation?

LET IT NOT be supposed from the foregoing that this journal opposes regulation. Its views on this subject were set forth in these columns last week, on page 588. But there are degrees of regulation. Without any regulation the utility gets all of the profit on what the traffic will bear. With regulation on the agency basis the consumers get all of the profit except a little more than the bare cost of production. Somewhere between these extremes lies fair regulation. The owners of the utility should be allowed the major part of the extra profit due to efficiency in management, and to a good part of that chargeable to good luck and the general prosperity of the public served. And certainly if the public shares in the profits it must share as well in the losses—applying itself as assiduously to the regulation of operating expenses, such as wages, as to the regulation of rates, and shouldering its share of what it and the utility cannot regulate, such as unprecedented floods.

"Threat Value"

IT IS GRATIFYING that at least one State commissioner—or rather former State commissioner—John M. Eshleman, does not approve of the agency theory. His more liberal views are suggested in the abstract, on page 625, of his address on the reproduction theory. In opposing this theory he develops the idea that the reproduction cost includes, besides the actual sacrifice of the investor, a goodly amount of what he terms "threat value," based on the monopolistic protection afforded by the public itself. But is not the characterization unfair in some respects? This journal's views of franchise values and other intangibles not paid for will be touched upon later. Is it quite just, however, to include unearned increment on land as part of "threat value?" Is not the desire of the utility to recognition of this increment as an element of fair value, when such recognition does not mean burdensome rate increases, a perfectly normal and reasonable desire to share in the general prosperity to which this increment testifies, and to which the utility has contributed in no small measure, rather than to a mean attempt to take advantage of a helpless public?

Interdependence of Railroad Rates

AND DOES NOT Mr. Eshleman, in classing the railroads with the local gas plant, commit the same error of which he accuses the reproductionists, that of thinking monopoly and competition at the same time? Some railroads are monopolies over large territories; all, perhaps, enjoy local monopolies to a certain extent. Even at best, or worst, however, the interdependence of rates plays an important part. If one road can make a profit hauling goods from A to B at a certain rate, and sees fit to establish that rate, all other roads from A to B must make the same rate, profit or no profit. Not alone is direct competition affected. The railroads running to C, which town competes with B, may not ignore the rates made to B by an entirely different set of roads, lest they be charged with discriminating against C. Within certain limits the Government allows the railroads to even up for low long-haul competitive rates by high short-haul monopolistic rates, but those who trace the actual operating movement and see the relative costs of switching and transit perceive that this system is not wholly inequitable. Seemingly the interdependence of railroad rates destroys a large part of the railroad's "threat value."

Which Would Shift First?

MR. ESHLEMAN and others called the reproduction method an engineer's invention devised solely to produce the highest figure. It was suggested that the utilities would promptly recede from their position if it were shown that reproduction cost would be less than original cost. Let us look at the other side of the picture. Suppose prices, including land values, had steadily fallen since the building of the plant. Would the so-called public care to allow a return on $1,000,000 because the plant cost that much, although it could be replaced for $500,000; or would not the company, rather, be charged with extravagance in construction, or lack of foresight, and allowed a return on present value only? This journal suspects that if reproduction cost should suddenly prove to be less than original cost there would be danger of a collision in the mad scramble of the two parties at interest to exchange positions.

Depreciation

THIS JOURNAL has repeatedly expressed its views on depreciation. In general it agrees with the railroads that in a properly maintained utility of unlimited life, spending about the same amount each year for renewals, such renewals are virtually operating expenses; that the public must pay such operating expenses; that it is not necessary to maintain a separate depreciation reserve as such, and that there should be no deduction of depreciation to obtain fair value. Special attention is called, however, to the point made by Mr. Allison, that it is utterly impossible to determine the service life of many of the units of the utility plant, and that the engineers should be more active in pointing this out. Those who doubt the significance of this should figure a sinking fund, compounding at 4 per cent, to renew a $1,000,000 bridge with an assumed life of twenty-five years, and then another fund, compounding at 4½ per cent, to renew the same bridge with the length of life estimated at fifty years. For such reinforced concrete structures as the Tunkhannock viaduct, put in service last week, reasonable guesses could vary between much wider limits.

Going Value

WHILE there was little agreement at the conference as to the definition of going value, there was fairly general agreement as to what part of it should be included in fair value. They would allow actual development costs in the early years, but disallow franchise values, enhancement from continued operation, and the other intangibles attaching to the going plant. The Engineering Record inclines to the same view, and believes the railroads can afford to allow such "other elements of value" as those of connected use or advantageous location to prove their existence automatically by heavy traffic, or low operating expenses, or both. But the method of measuring these development costs proposed by Mr. Thorne does not seem satisfactory. He would require proof of early losses, uncompensated by later excessive profits. One might suspect the father of this thought to be the knowledge that seldom if ever do the books show the full development costs. In any event measuring these costs by existing deficits or lack of them rewards poor management at the start and penalizes early effectiveness, as has frequently been pointed out. Mr. Thorne recognizes this, and so would exclude from consideration all but the early experimental years; but surely Mr. Hagenah's plea for allowing the continuous development expenses of the municipal utility in the rapidly growing city is pertinent. It would seem that in this question of going value the fairest results will be obtained by the co-operation of the parties at interest in estimating what the development ought to have cost. In such an event the public's representatives should see that every legitimate item is admitted, even down to the present time, while the utility should recognize that the development cost of plant enlargement, such as the four-tracking of an established double-track railroad, is less proportionally than that of plant newly created, such as the original single track built into pioneer territory.

Drawing the Curtain on the Past

MUCH was said in favor of drawing the curtain on the past—not, however, when going value was being discussed. Thus is human nature portrayed. The past is pertinent in going value, they say, evidently because the utilities usually cannot substantiate in figures their claims for development expenses that must have been incurred. On the other hand, evidence of subsequent large dividends can be found; hence the utility loses both ways when the past is explored. With depreciation the advantage is reversed. The public demands that the utilities produce depreciation reserves. The utilities cannot. Clearly, therefore, these reserves, which do not exist, have no value. The utilities claim they were never allowed to earn these reserves. Let us draw a curtain on the past, and begin anew.

Keeping the Engineer in His Place

AS IS USUAL in these mixed gatherings, the engineer was kicked around considerably by the lawyer and the economist. According to Professor Gray, the engineer is in no way fitted to discuss questions of value and wealth, and his testimony on these matters is never regarded seriously by the economist. In general, neither the economist nor the lawyer hesitates in these discussions to put the engineer in *his* place, but both are shocked when the engineer attempts to define *their* functions. Under these circumstances, is the engineer going to stay "put," or is he going to assert himself? Is he going to admit that the *hours* he spends on the valuation details of plant with which he is familiar are worth less than the *minutes* spent by lawyers and economists on details of plant with which they have no acquaintance?

Degrees of Worthlessness

IT is true that Professor Gray, after delivering the engineer his staggering blow, applied the smelling salts himself. In other words, after proving that none of the expert testimony of engineers in valuation cases was of any account, he uttered the sad plaint that the railroads, by pooling their interests, can afford to get all of the best of these engineers. Furthermore, reputable engineers, it seems, are unwilling to tell the truth for the Government, for fear of damage to their future business. Consequently the public is at an unfair disadvantage, and the railroads win by sheer numbers of witnesses. Reverting to the original theorem, that none of these engineers are worth anything as witnesses, the equation may be expressed thus:

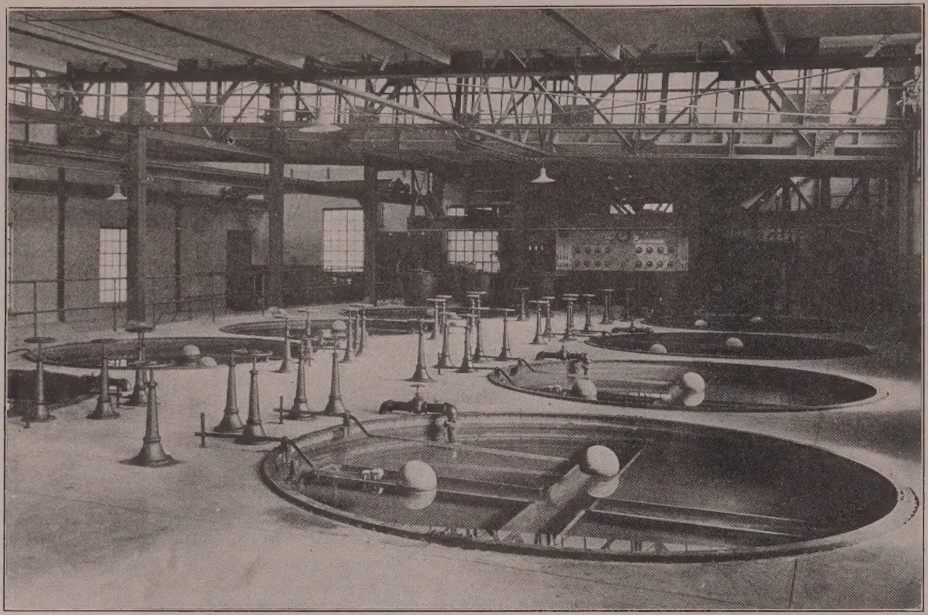
$$10 \times 0 > 5 \times 0$$

As the Engineer Sees the Conference

CONSIDERING the conference as a whole, there seems to have been much abstract theory presented, but not so much practical suggestion. The criticism was destructive rather than constructive. So many times the speaker seemed to fall just short of a definite conclusion. Usually one learned what he did not favor; often one was left in doubt as to just what he did advocate. At present the valuation question seems to divide into two parts: How to make present valuations, particularly the Federal valuation of the carriers, in accordance with existing law; and how to work out a definite and just basis for the future. As to the first part, the conference did not get down to this level and grapple with the actual problems being encountered. As to the second, the theories propounded seemed, as already stated, to be based on concepts of what existing law means and not on fundamental ethics.

Rays of Light

HAVING objected to most of the theory developed at the conference, the Engineering Record is glad to commend a few detail suggestions. The method of obtaining reproduction cost of land explained by Mr. Hayes (see page 626) is worthy of careful consideration. It appears to be all that Mr. Hayes claims for it, a means of getting in evidence what railroads probably would have to pay to reproduce their right-of-way, and at the same time avoiding rejection by the courts because of conjectural items. The importance of maintaining as well as making inventories was well set forth by Mr. Pillsbury. Valuation by approximation as used by Mr. Morse in insurance valuations would probably not be acceptable to the courts in their present attitude, but the idea is excellent and it would certainly be desirable to get away from hair-splitting in inventorying small items when estimates must serve for much larger ones.



EIGHT MECHANICAL FILTERS MUST SUPPLY PURE FEED WATER FOR 40,000 BOILER HORSE-POWER PLANT

Softening Plant Converts Hard, Impure River Water Into Boiler Feed Supply

Chemical Treatment by Intermittent System and Rapid Filtration Reduce Steam Generating Costs at Youngstown Sheet and Tube Mill

BY THE INSTALLATION of a water softening and purification plant, comprising eight steel reaction and settling tanks, 30 ft. in diameter and 26 ft. high, two sets of three reagent mixing tanks and eight mechanical filters with a combined capacity of 4,000,000 gal. daily, it has been possible for the Youngstown Sheet & Tube Company to convert the hard, contaminated flow of the Mahoning River into a satisfactory boiler feed water and to make an appreciable saving in the cost of steam generation and boiler maintenance. The treated water, it has been found, does not contain any permanent hardness and the remaining lime and magnesia salts are reduced to less than their solubilities in distilled water. Such a water, experience has shown, does not form boiler scale or cause corrosion, for the small amount of lime and magnesia salts left in the water are of such a character that when precipitated as a result of concentration in the boilers only a slight quantity of sludge is formed. The following data regarding the new works were supplied by J. C. W. Greth, who, until his death last August, was manager of the water purifying department of the William B. Scaife & Sons Company of Pittsburgh, which supplied the equipment for the Youngstown plant.

At the mill 30,000 boiler horse-power are in service, operated at an average load of 125 per cent of rating or at the rate of approximately 40,000 hp., requiring the evaporation of 4,000,000 gal. of water.

STREAM FLOW VARIABLE

The stream flow of the Mahoning River varies considerably. The average minimum flow per 24 hr. is 15,000,000 gal. The average maximum daily flow is 13,000,000,000 gal. The mean average daily flow is 776,000,000 gal. The minimum daily flow has often been as low as 10,000,000 gal. The maximum flow of water is hardly equal to all of the demands of various plants along its banks in Youngstown at all seasons of the year. The daily use of water from the Mahoning River, in passing through Youngstown, is approximately as follows: City of Youngstown, 12,000,000 gal.; Carnegie Steel Company, Ohio works, 70,000,000 gal.; Brier Hill Steel Company, 50,000,000 gal.; Republic Iron & Steel Company, 110,000,000 gal.; Youngstown Sheet & Tube Company, 150,000,000 gal.; total, 392,000,000 gal.

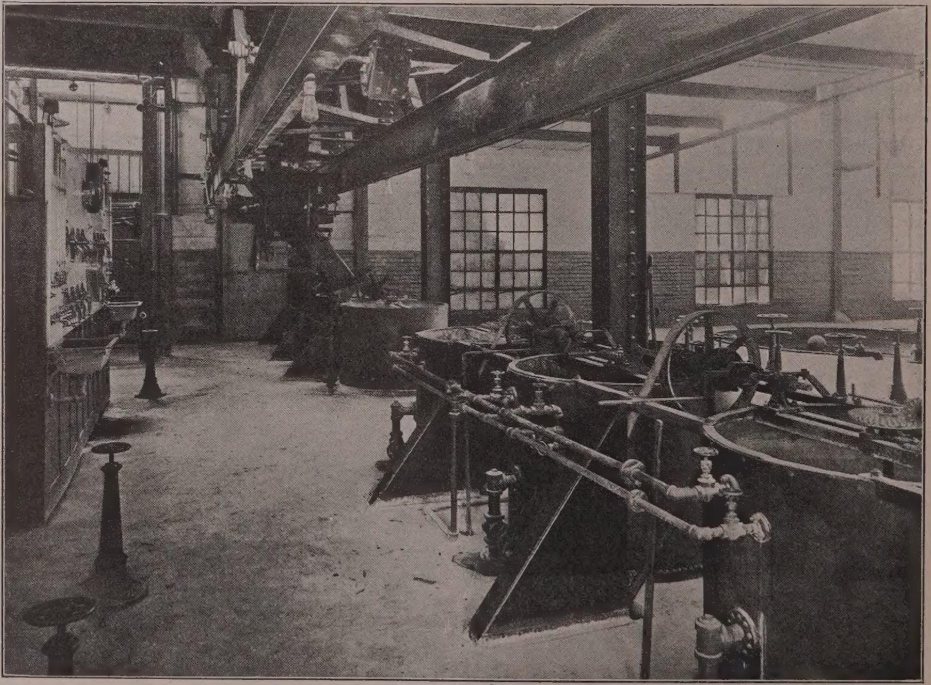
This list, of course, does not include the smaller users. It is only possible to obtain sufficient water from the river by means of dams, forming pools, which become merely circulating basins for each plant. Were it not for the fact that the city and the manufacturing concerns along its banks return their sewage and waste into it there would be very little water in the river except at flood stages. The water supply is badly contaminated in addition to the hardness which it contains. On Aug. 8, 1914, the river water had a temperature of 127 deg. Fahr. at the intake of the plant of the Youngstown Sheet & Tube Company.

The analyses in Table 1 will illustrate the range of the mineral impurities in this supply that are of interest in connection with boiler feed water, and which vitally affect the cost of steam generation and boiler maintenance.

TABLE 1—RAW WATER, MAHONING RIVER

	Grains per U. S. gallon				
Volatile and organic matter	1 05	1 30	25	1 65	1 90
Silica	85	45	35	45	55
Iron and alumina oxides	15	05	trace	05	25
Calcium carbonate	66	2 54	6 27	5 75	8 48
Calcium sulphate	2 99	6 26	4 59	9 18	61
Magnesium carbonate	94	1 66	.. ..	.. ..	.. ..
Magnesium sulphate	..	..	5 40	4 56	5 07
Magnesium chloride	27	68	.. ..	.. ..	.. ..
Magnesium nitrate	14	27	.. ..	.. ..	.. ..
Sodium sulphate	..	..	96	7 60	4 37
Sodium chloride	16	48	4 12	10 55	3 46
Sodium nitrate	..	..	31	.. ..	.. ..
Total solids	7 21	13 69	22 25	39 79	24 69
Suspended matter	8 75	45	35	75	29 10
Free carbonic acid	33	33	22	10	33
Incrusting solids	6 00	11 91	16 61	19 99	14 96
Non-incrusting solids	16	48	5 39	18 15	7 83

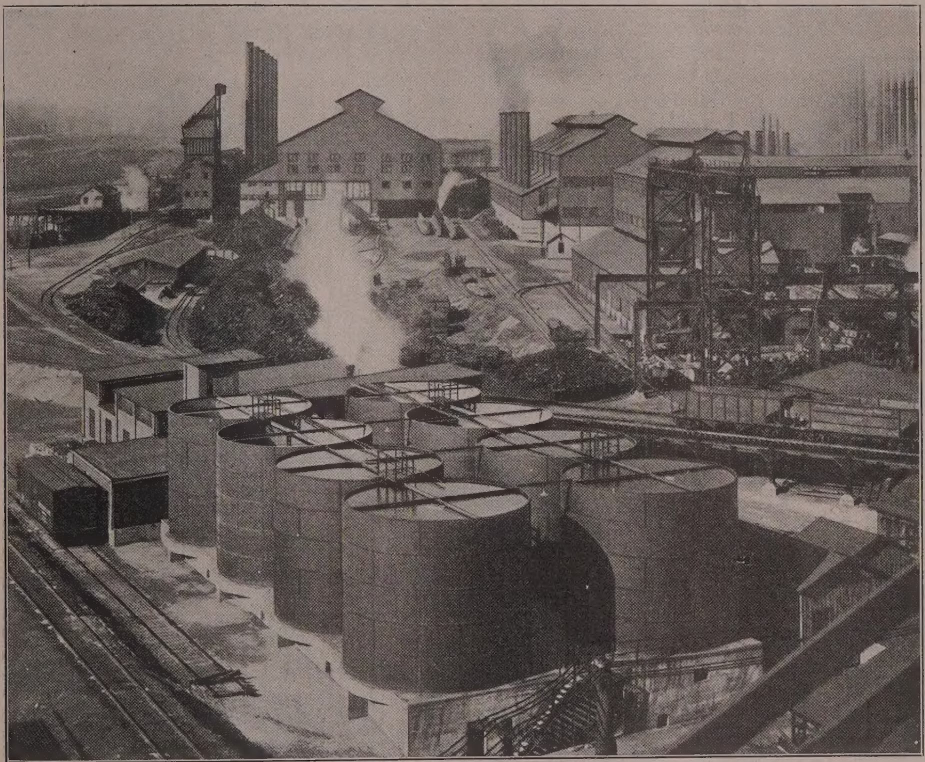
It will be readily noted from the analyses that while rainfall reduces the hardness of the water there seems to be no regular rule that can be followed, since there is neither a regular reduction in the various impurities nor any regular increase. The principal impurities are the different lime and magnesia salts; a variation in any one of these substances involves a change in the treatment. While, as a rule, only two reagents, lime and soda ash, are employed in softening water, some of the impurities,



CHEMICALS FROM OVERHEAD BINS ARE WEIGHED AUTOMATICALLY BEFORE REACHING THE REAGENT MIXING TANKS such as magnesium sulphate, affect the quantities of both lime and soda ash required. On the other hand, any variation in the carbonic acid contained in the water affects only the lime treatment.

SOFTENING SYSTEM INTERMITTENT TYPE

The We-Fu-Go water softening and purifying system, built by William B. Scaife & Sons Company of Pittsburgh, was the system installed to effect the purification of this water. It is a system of the intermittent type in which definite quantities of water are treated all the time with predetermined weights of reagents.



THE EIGHT STEEL REACTION AND SETTLING TANKS ARE FITTED WITH MECHANICALLY OPERATED STIRRING PADDLES

The water to be purified is pumped from the river to a barometric condenser by an 18-in. DeLaval centrifugal pump, having a capacity of 13,600 gal. per minute against a head of 36 ft. The condenser has a capacity of 240,000 lb. of steam per hour. From the hot well of this condenser the water flows by gravity to the raw water well of the water purifying system, whence it is pumped to the reaction and settling tanks of the water purifying system. The advantage of using this condensed steam is, first, in its temperature; second, in the dilution of the water by condensed steam; and, third, in the saving of water. The objection to its use is the lubricating oil which must be removed in the treatment to make it fit for boiler feed use. This is effectively taken care of in the apparatus installed.

The system consists essentially of eight steel reaction and settling tanks, 30 ft. in diameter and 26 ft. high, each holding 120,000 gal. of water. About 2 ft. in the bottom of each tank is allowed for sludge storage. Each tank is equipped with mechanical stirring devices operated by an electric motor. There are two sets of three reagent mixing tanks, with power-operated stirring devices; three centrifugal pumps for introducing the reagents into the reaction and settling tanks; and eight mechanical gravity filters of steel, each 15 ft. in diameter and having a capacity of 500,000 gal. of water per 24 hr. The piping connecting the treating tanks to the filter headers are so cross-connected that any one or all of the treating tanks can be connected with any or all of the filters. It is also possible to use the water directly from the settling tanks without the use of the filters. Means are provided for supplying the settled water for filter washing, doing away with the necessity of wash pumps for this purpose. All the main valves in connection with the treating tanks are hydraulically operated from an operating board, located in the building in which the filters are located. All other valves are operated by means of extension stems and stands through a universal coupling.

CHEMICALS AUTOMATICALLY WEIGHED

The chemical reagents are stored in hopper-bottom bins in the floor above the reagent mixing tanks. The reagents are taken directly from the cars to the storage room by means of an elevator. The storage bins discharge into movable reagent hoppers, one for each set of reagent mixing tanks. The reagent hoppers are fitted with Fairbanks, Morse & Company's automatic scale, which enables the operator to deliver the proper quota of reagents to the various reagent mixing tanks. Three American centrifugal pumps are used for delivering the reagents from the reagent mixing tanks to the reaction and settling tanks. These pumps are cross-connected so that they can operate with any reagent tank or tanks to deliver to any one of the eight reaction and settling tanks. The reagent mixing tanks are fitted with mechanically operated stirring devices to facilitate the dissolving of the reagents.

FILTER STRAINERS UNIQUE

The filters are of the mechanical gravity type fitted with the usual pipe manifold, into which Scaife strainers are screwed. These strainers are of unique design, consisting essentially of an outer and an inner cone of sheet brass and a cast-brass base. The base is spun onto the outer cone, the inner cone being free to move up and down. The outer cone is slotted parallel to the base of the strainer; the inner cone has openings at right angles to the slots of the outer cone. During the regular operation of the filters the full area of the openings in the outer cone is available for carrying the water from the filter. During the washing process the inner cone moves up and closes off a number of the openings in the outer cone so that the total of the openings equals the discharge of wash water through the wash main into the filter bed. This insures a uniform distribution of the wash water to all parts of the filter bed, using a minimum of wash water, and, since the water enters the filter at high velocity, effects an efficient wash.

The filters are provided with an air wash system, air being supplied by a positive air blower operated from the line shaft, driven by the motor which operates the stirring devices in the reagent mixing tanks. The filtering material consists of graded crushed quartz supported by a layer of gravel. The flow of the water to the filters from the reaction and settling tanks and from the filters to the clear well is controlled by means of balanced valves and copper floats.

The stirring devices in reaction and settling tanks are operated by electric motors, one for each row of tanks, and consist of slow-moving paddles set at an angle to give the water the much-desired rolling motion so essential for thorough mixing and aiding the completion of the reactions, as well as to prevent the breaking up of the precipitate into fine, slow-settling particles. The paddles are located in the bottom of the tanks and mix the sludge of previous purification with the incoming water; about 24 in. are allowed in the bottom of each tank for the storage of this sludge, which is a factor in the treatment of the water.

HOW SYSTEM OPERATES

The operation of this system is briefly as follows: One or two reaction and settling tanks may be treated at a time, depending upon conditions; usually, however, only one tank is treated at a time. While a tank is filling the reagents are introduced and thoroughly mixed with the water, by means of the stirring device, which not only mixes the water and reagents, but the sludge of preceding purification. This sludge floats in the water, hastens the chemical reaction and causes the new, finely divided precipitate to form large, woolly flakes, heavy enough to settle quickly as soon as the water stops moving. After a tank is filled the stirring device is stopped and the water permitted to stand in order to allow the precipitate to settle to the bottom of the tank. The softened water is taken out of the tank by means of a hinged floating outlet pipe, arranged to rise and fall with the level of the water, so that the water is always drawn from the top. The water at the top being the clearest, carries the least amount of floating sludge through the floating outlet pipe to the filter, thus reducing the filter cleaning to a minimum.

The washing of the settling tanks needs only to be done about once a week. This is accomplished by opening the valves to the sewer and starting the stirring devices to mix up the sludge, which is soft enough to

Table 2—Treated Water, Mahoning River

	Grains per U. S. gallon				
Volatile and organic matter	1 25	1 15	65	65	75
Silica	80	45	45	75	65
Iron and alumina oxides	05	trace	trace	trace	trace
Calcium carbonate	1 25	75	75	88	1 14
Magnesium carbonate	..	.. ..	.. ..	.. ..	29
Magnesium hydrate	12	20	67	48	44
Sodium carbonate	1 42	1 50	1 44	1 78	1 08
Sodium sulphate	3 91	15 76	23 43	18 46	7 35
Sodium chloride	99	7 42	11 37	10 22	2 31
Sodium nitrate	08	.. ..	.. ..	.. ..	16
Sodium hydrate	64	52	08	94	.. ..
Total solids	10 51	27 75	38 84	34 16	14 17
Suspended matter	..	trace	05	trace	trace
Free carbonic acid	none	none	none	none	none
Incrusting solids	2 22	1 40	1 87	2 11	2 52
Non-incrusting solids	7 04	25 20	36 32	31 40	10 90

flow. When the filters require washing the settled water from one of the reaction tanks is used for this purpose.

Results of Treatment

The softening results obtained from this installation are shown by the analyses of the softened and purified water in Table 2.

It will be noted that the softened water does not contain any permanent hardness and that the remaining lime and magnesia salts are reduced to less than their solubilities in distilled water. Such a water, it has been found, will not form scale or cause corrosion, for the small amount of lime and magnesia salts left in the water are of such a character that when precipitated as a result of concentration in the boilers only a slight sludge is formed. By washing out with a good pressure or by rubbing with the finger the metal of the boiler can be exposed. Corrosion can not occur, it is claimed, because the purified water contains neither corrosive acids nor substances which, in the boiler, can produce such acids. These analyses also show a uniform quality of the purified water from this variable supply so that the improvement in boiler operation and maintenance charges is believed to justify the installation.

Seattle Harbor Improvements made during the past three years have cost approximately $6,100,000, and include wharves, transit freight sheds and warehouses. All of the units are now completed and in operation except a seven-story concrete fruit warehouse, of which five floors are up; a two-story wharf, and a public cold storage plant.

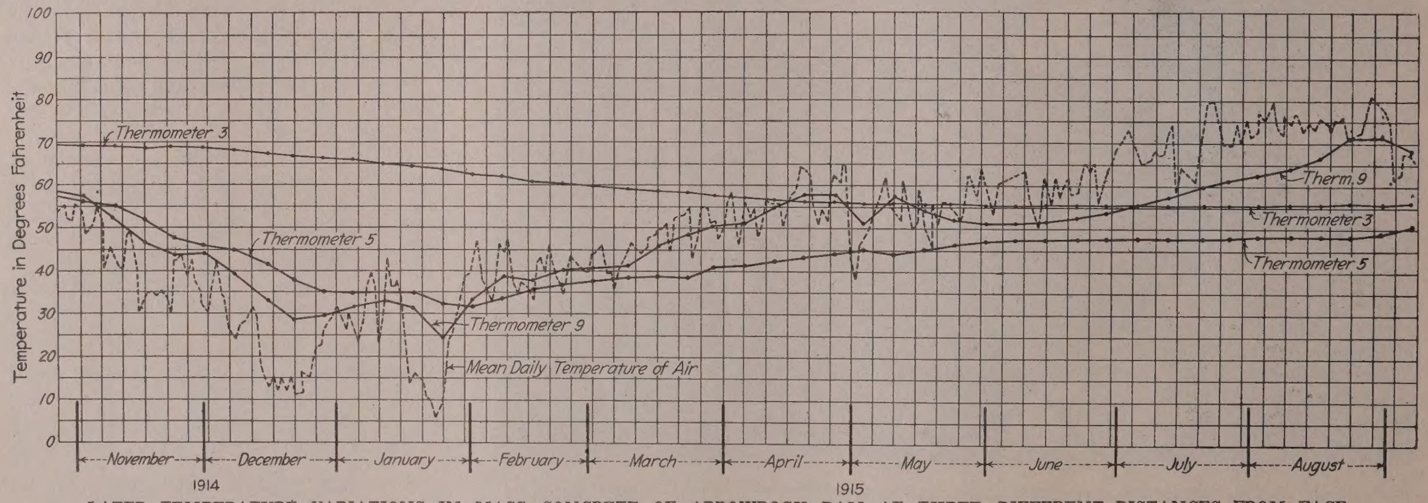
Mass Concrete Retains Setting Heat Several Years

Records During 1915 from Thermometers in Arrowrock Dam Confirm First Conclusions Reported by C. H. Paul and A. B. Mayhew

Further conclusions are reached regarding the temperature variations in mass concrete as the result of nearly a year's additional records in the testing of temperature variations being made at the Arrowrock dam. In the closing discussion of their paper on this subject, which was abstracted in the Engineering Record of June 5, page 710, Charles H. Paul and A. B. Mayhew, in the *Proceedings* of the American Society of Civil Engineers for October, page 2009, state that none of the new results tends to contradict any of their original conclusions. The following abstract includes the new conclusions and the principal points of interest brought out by the later records, which are shown in the accompanying diagram for the thermometers 3, 5 and 9.

Effect of Water in Reservoir

The record of thermometer 5 compared to that of thermometer 9 shows the effect of the water in the reservoir on the temperature of the concrete close to the upstream face. The water was above the elevation of thermometer 5 after Feb. 26, and the temperature of the water at that elevation was between 32 and 52 deg. during the remainder of the period shown on the diagram. At the elevation of thermometer 9, covered from May 11 to Aug. 24, the water was considerably warmer, especially after the early part of August, when the surface was not far above that elevation.



LATER TEMPERATURE VARIATIONS IN MASS CONCRETE OF ARROWROCK DAM AT THREE DIFFERENT DISTANCES FROM FACE

Thermometer 9 is 1 ft. and thermometer 5 is 3½ ft. from the east or upstream face. Thermometer 3 is 20 ft. from the west face.

With records of nearly 2½ years for some of these thermometers, and after having the reservoir filled within 28 ft. of the top of the dam during the season of 1915, all of the thermometers, with the exception of No. 2, continue to give readings that indicate perfect condition of the apparatus. This is gratifying to the engineers in view of the difficulties experienced heretofore in obtaining satisfactory results for any length of time with similar apparatus.

By taking advantage of the inspection galleries it has been possible to measure the movement of fifteen of the expansion joints, spaced 50 ft. apart, not only at the upstream face of the dam, but also at the upstream and downstream walls of the inspection gallery, 16 ft. and 22 ft. respectively in from the upstream face of the dam. The accompanying table gives the average maximum opening, and the average subsequent minimum opening of these fifteen joints.

These records are for one season only, and undoubtedly the heat in the concrete due to setting was still being felt.

Average Maximum and Minimum Openings of Fifteen Expansion Joints in Arrowrock Dam

Location of joints	Maximum in.	Minimum in.
At upstream face	0.0708	0.0064
In 16 ft. from upstream face	0.0444	0.0300
In 22 ft. from upstream face	0.0324	0.0240

New Conclusions

The following conclusions can be added to those given in the original paper:

6. (Superseding 6 in the paper.) The seasonal variation in the temperature of concrete 10 ft. from an exposed face is about 12 deg., when the seasonal variations of the mean daily temperature of the air is about 72 deg.

7. The seasonal variation in the temperature of concrete 20 ft. from an exposed space is very little, and after the effect of "setting heat" has once been overcome, the change in temperature of concrete at that distance from an exposed face is so slight as to be negligible under ordinary conditions.

8. The effect of the "setting heat" in concrete 20 ft. or more from an exposed space is felt for several years after the concrete is placed. Concrete near the center of the mass of a large dam probably retains some of its "setting heat" for five years or more after placing.

9. Contraction joints are desirable in all large concrete structures, whether or not they are to be exposed to wide variations in outside temperature, except possibly when all construction may be carried on during cold weather and when the variation of outside temperatures, after completion, would be slight.

10. Changes in volume due to setting, hardening, and seasoning of concrete are more important ordinarily, excepting at points very close to exposed faces, than changes in volume due to the influence of daily or seasonal variations in outside temperatures.

Similar investigations at the Kensico dam of the Catskill aqueduct tend to confirm these conclusions.

Reproduction Basis of Valuation Criticised

John M. Eshleman Calls Railroads Shortsighted in Trying to Realize on "Threat Value" Far Above Cost—Warns Against Government Competition

THE REPRODUCTION theory of valuation was sharply criticised at the valuation conference in Philadelphia last week. The agency theory of regulating utilities was advocated by many, and if this theory be correct there is little room for argument for value based on reproduction cost. John M. Eshleman, Lieutenant-Governor of California, and formerly president of the State railroad commission, found objection to the reproduction method by a different line of reasoning, as he does not support the agency theory. He developed the idea that much of the value of the protected monopoly is "threat value," based upon the consumer's necessity for the monopoly's product; that the public may, if the threat price becomes too high, make a counter threat of ruining the utility by entering into direct competition with it; that reproduction cost as interpreted by the utilities, particularly by the railroads under the Federal Valuation Act, includes absurd and intolerably extravagant claims for hidden and intangible items that would make for a total far in excess of the investors' real sacrifice, and that if such a sacrifice be allowed the public will be forced to compete with the utilities "until they shall be of a reasonable mind." He does not specify absolute rules for valuing existing utility property, but urges the co-operation of all concerned in attempting to reach the just and fair result.

Mr. Eshleman's address was in part as follows:

It is unfortunate from the standpoint of clearness that the term "value" has ever entered into the discussion of the regulation of utilities. It has no place there and can not, in the nature of things, be an element to be considered in solving the problems that must be solved either in fixing rates or in determining a price which shall be paid for a utility property.

"THREAT PRICE"

Let us assume, for the sake of argument, that the desire to preserve actual physical life in an extremity will ordinarily cause the surrender by the person involved of more possessions not directly useful for the prolongation of life than will any other motive. Assuming this to be true, the one in possession of the only supply of food can always take from a person in dire need of such food all of his other possessions. Thus we see that value, viewed subjectively as it ought to be, is always determined comparatively and personally—comparatively because the sacrifice that will be made by the one in whose mind the value is fixed is determined by the sacrifice that must be made to secure a substitute for the thing valued; and personally because the ultimate sacrifice that will be made to secure the object is determined by the estimate the one valuing puts upon the desirability of his condition in possession of the object and not in possession of it.

Price, therefore, when determined independent of cost is merely the money or barter equivalent of the value thus determined. Its maximum is limited solely under certain conditions by the resources of the buyer; its minimum under certain other conditions may even be nothing. In the case just referred to, the one in possession of the sole supply of food, if so minded, might take all the one in need possessed, but plainly the amount that could be taken as the price would be determined and limited absolutely by the amount possessed by the purchaser and would have no relation whatsoever to the cost to produce the article sold; it might be many times more, or much less, than the cost price. The price thus determined for lack of a better name I shall call "threat price."

From the standpoint of society, however, it is always desirable that prices charged shall have a reasonable relation to cost price. Mankind as a whole is interested in any plan which tends to determine rewards in relation to efforts. As a part of organic society we each admit the justice and desirability of this as an abstract proposition; as an individual we also each admit both its justice and its desirability as concerns the other fellow when dealing with us; but we always instinctively shrink from accepting it and applying this rule to ourselves and the concrete enterprise we have in hand. Mankind is so constituted that if left free to work upon the necessities of others it has uniformly taken good measure for its service, and a study of the activities of those in control of necessities and possessed of the power to impose a threat price demonstrates that they do so when permitted.

PROTECTED MONOPOLIES

But in the realm of a public utility we have a situation that is peculiar. We have here an agency that to many of its patrons always is a monopoly, and if properly controlled it should be permitted to continue as a monopoly.

But so soon as we admit that public utilities or natural monopolies should not be destroyed as such monopolies, then do we present the necessity of devising a method of preventing them from imposing a threat value and securing a threat price. In short, we say to these agencies, "You may not be permitted to take all you can get. Government will only allow you what you ought to take."

When we are left to determine the earning an agency ought to take, we always will have primarily before us what the agency has done; what effort it has put forth; what sacrifice it has made. And when, having marshalled all the facts that may be secured bearing upon this main question, we have fixed an earning or have determined a basis upon which an earning should be permitted, then this basis is the "fair value" of the property. Does the reproduction theory of valuation meet these requirements?

Reproduction value is based upon what it would cost another or the governmental agency itself to build a similar plant entirely independent of the need of such duplicate plant. The owners of these properties have brought themselves to that state of mind that they feel that the price to which they are entitled is determined not by what they have sacrificed, but by what they can force the prospective buyer to pay. And their theory grows up from the analogy of prices fixed under competition when their prices can not be fixed under competition. Are the utility owners any more justified in contending that the just price is determined by the answer to the question, "How much can we force them to pay rather than go elsewhere?" when there is nowhere else to go, than the public would be in asking, "How little can we force them to take rather than be ruined?" One is certainly no more devoid of equity and justice than the other. They are both threats alike.

TWO BARS TO REPRODUCTION THEORY

There are two absolute bars to the application of the reproduction theory of valuation to utilities. The one is the impossibility of imagining the monopoly never to have existed and the conditions which such monopoly has produced still there; of thinking of the effect of a certain known cause and at the same time conceiving such cause never to have operated. The other is the impossibility of thinking monopoly and competition at the same time; the impossibility of having the condition of the property of a monopoly affected by a duplicate competing agency and still remain unchanged.

Justice Hughes discusses the first difficulty in the Minnesota Rate Case. He there says:

"Moreover, it is manifest that an attempt to estimate what would be the actual cost of acquiring the right-of-way if the railroad were not there, is to indulge in mere speculation. The railroad has long been established; to it have been linked all activities of agriculture, industry and trade. Communities have long been dependent upon its service, and their growth and development have been conditioned upon the facilities it has provided. The uses of property in the communities which it serves are to a large degree determined by it. The values of property along its line largely depend upon its existence. It is an integral part of the communal life. The assumption of its non-existence and at the same time that the values that rest upon it remain unchanged is impossible and cannot be entertained. The conditions of ownership of the property and the amounts which would have to be paid in acquiring the right-of-way supposing the railroad to be removed are wholly beyond reach of any process of rational determination. The cost-of-reproduction method is of service in ascertaining the present value of the plant when it is reasonably applied and when the cost of reproducing the property may be ascertained with a proper degree of certainty."

Those urging the reproduction theory to determine the price upon which an earning shall be allowed are confronted with a very interesting dilemma. If their theory is to deal with the very property in question as a monopoly, they cannot, as Justice Hughes points out, think it away and at the same time have the results that come from its presence. On the other hand, if it is an alternative proposition which they urge and the thing which they have a right to exact is that which the public or a competitor would have to pay to put in a second plant identical with their own, they have to be confronted with the results of such duplication and they come face to face with the thing I have had in mind from the beginning, namely, the threat power of the public.

Owners of public-utility property would never for a moment contend for the reproduction theory if they thought the public would take them at their word. For as far as price is concerned under this theory it is utterly immaterial to the public whether they buy the existing utility property or leave it there and proceed to duplicate it. For do not the proponents of this theory seek to capitalize not only the physical property but every known disadvantage to the public, such as paving over mains, for example, and every known or imagined advantage to themselves, such even as having consumers attached to the system? And they place their reliance on one thing alone and that is that the public, if they should build a competing utility in this field, would lose money because of the dividing up of the business. On this they pin their hope when they pile Ossa on Pelion in piling up the items with which the public shall be taxed. By what license do they forget that the loss of business by duplication will fall on them too?

RAILROAD POLICY SHORTSIGHTED

It is not by way of criticism that I call attention to the program of the utilities to-day. They are merely following a natural business course, shortsighted, however, in my opinion, if the public is awake. To-day the Interstate Commerce Commission is engaged under an act of Congress in collecting data concerning the railroads of the United States. The railroads quite naturally are attempting to determine the lines upon which the inqury shall be prosecuted, and the results that shall be obtained. I have confidence in those directing this valuation, and I have no fear that they will not do all in their power to secure the information fairly and make their determination intelligently and fearlessly. But the fact that tremendous sums are being expended by the representatives of the railroads in hunting for hidden quantities and the like, and in seeking in every way in their power to affect the determination of this question in a way favorable to themselves, should put the public on guard lest their side be not properly presented. It is my belief that if the Interstate Commerce Commission should adopt the reproduction theory of valuation as the proper price upon which the railroads should be permitted an earning—which would ultimately determine the price which the public would be required to pay for these roads if public ownership should prevail—a result will be produced which will make it necessary for the public to resort to its threat power and compete with these agencies until they shall be of a reasonable mind.

I recognize the very general character of the rule I suggest, but of necessity it must be general. For the future always the cost of doing the business should be the aim. Of course in this will be included every legitimate element of cost. Always such cost must stand the comparison with costs under publicly owned utilities. For the past we should allow such a basis for earning as equitable considerations warrant, never enhanced because the agency is a monopoly and determined in view of all the facts that can be ascertained. In marshalling these facts the work of the engineer in determining quantities and unit costs as bearing upon what the property should have cost under ascertained conditions and the work of the accountant in analyzing actually located expenditures are but complements to each other. Each is extremely important, but neither alone under the conditions under which utilities have been conducted in the past suffices finally to solve our problem.

I conclude that as far as the past is concerned it is impossible to know in any case that we have done absolute justice involving utility property, but I contend we may be assured within reasonable limits in any given case provided there is co-operation by all concerned in attempting to reach the just and fair result. But I am quite sure that the cost-of-reproduction method as now being used, or rather abused, is getting us farther from the solution of the problem rather than nearer to it.

Land Reproduction Cost Figured by a Definite Method

Applying to Present Normal Prices Basic Ratio at Time of Original Purchase Is Claimed to Eliminate Conjecture

WHAT has been called an engineer's method of determining the reproduction cost of railroad land for valuation purposes—a method that aims to eliminate the conjectural, speculative features objected to in the Minnesota rate decision, and one that has, the Engineering Record understands, been applied on the Kansas City Southern Railway—was described by Hammond V. Hayes, consulting engineer, of Boston, at the valuation conference last week in Philadelphia. It consists simply in finding the normal basic value of adjoining land at the time of purchase of the railroad right-of-way, as well as the price actually paid for each parcel. With these two a ratio or multiplier is obtained representing what the company was originally obliged to pay as compared with the prices prevailing in ordinary voluntary sales. This ratio, then, applied to the present normal basic value, will, Mr. Hayes contends, give the amount the company would now be obliged to pay for its right-of-way, including all claims for damages, severance or suitability.

Following is an abstract of the part of Mr. Hayes' paper describing the method:

An analysis of both the original cost and the cost of reproduction of land shows that each may be divided into two parts, (1) the figure which would be assigned in condemnation proceedings as the price which a company should pay for the land acquired by it, and (2) the costs of condemnation, of damages, and of purchase.

BASIC RATIO

The method which should be employed in ascertaining the first portion of both the original and the reproduction cost is that in which the normal market value is ascertained of adjacent similar lands as revealed by the prices paid in voluntary private sales, both at the time of the original acquisition of the lands by the company and at the time of the appraisal. This method has been extensively used as a normal basis for the ascertainment of the reproduction cost. There are two features of the recommended method, however, which need particular emphasis: That the normal sales value of adjacent similar property should be found, not for the time of the appraisal alone but as of the date of the original acquisition of the land under valuation, and that each parcel of land—a parcel being defined as a separate and distinct purchase—be associated with similar adjacent lands of which the past and present market value can be ascertained. In addition to the two normal basic figures thus found, the amount paid to the original owner of each particular parcel should be found and entered against that parcel.

By this method the price paid by the company and the normal market value at the time of purchase are shown for each particular parcel, and there is revealed, by the ratio between these two figures, the difference between the cost to a company of its land and the amount which was paid at that time in voluntary normal sales of similar land. Moreover, as the date of acquisition is given, it will be possible, in many instances, to determine, for land similar in character, the trend of this ratio from early days to the date of the appraisal. The ratio of the price the company has actually paid for its land to the normal market value of adjoining similar lands is thus established in a distinct and convincing manner, and a ratio is established by the use of which the reproduction cost may be found from the normal market value of similar and adjacent land at the time of the appraisal.

Difficulties will be found with this method, and the research will be laborious and expensive in many cases. On the other hand, the courts and the rate-making tribunals must have facts, represented by figures which can be supported, to show that a public-utility company did not and does not pay the normal market price when it acquires land, that it has always paid, and would be liable to have to pay at the time of valuation, the normal price increased by a definitely established multiplier.

ASSUMPTION ELIMINATED

The figures obtained through the use of the method above advocated give the original cost, and, for the reproduction cost, the price which a company has paid and in all reasonable probability would have to pay at the present time for the land now used for the benefit of the public. It eliminates the necessity of any assumptions as to what a company has paid or would have to pay for encumbrances upon the property, or for severance, for damages, for suitability or similar claims which in the past have been made in many claims for land values. The actual cost to the company of the land which it owns includes all such elements of value. They are shown as far as they need be by the difference between the market value of adjacent similar lands and the prices actually paid. There is introduced no element of personal opinion or judgment, however honest and wise.

An objection may be raised to these groups of figures on the ground that the company may have paid originally more than it should. This objection cannot be well taken in such cases, as the land had been acquired through condemnation proceedings. Such evidence is definite and convincing. On the other hand, where land has been acquired by private purchase, the company should be given the benefit of the doubt.

All conjectural figures based on claims for recognition of special value arising from the fact that a company owns and uses a continuous strip of land for its right-of-way, or a large area of land for its terminal purposes, or that its rights-of-way and terminals are peculiarly well suited to railway purposes, or that that land was not acquired free from encumbrances nor could be reproduced free from probably more expensive encumbrances, or similar claims for a larger reproduction value, are entirely eliminated.

INTERSECTION OF OAK HILL AND FRISCO CUTS—TEMPORARY BRIDGES IN FOREGROUND, SECTIONS OF PERMANENT BRIDGE BEYOND

Elimination of Tower Grove Grade Crossings at St. Louis Completed

Two Intersecting Streets Crossing Two Non-Parallel Railroads Make Complex Problem—Streets Carried Over Tracks on Reinforced Concrete

VIRTUAL completion of the elimination of the grade crossings at Tower Grove, St. Louis, was signalized July 31 by the opening of all streets involved. The matter was first brought up in 1905. The fact of two avenues, Tower Grove and Vandeventer, crossing on fairly level ground two railroads, the Missouri Pacific, and the St. Louis & San Francisco (Frisco), nonparallel and only 300 ft. apart, and the avenues themselves intersecting between the railroads, afforded an ample field for study; and in the seven or eight years between the first agitation and the adoption of the final plan three distinct methods of treatment were broadly discussed—depressing the street the full depth, depressing the tracks the full depth, and combining track depression with street elevation. The last plan was adopted, and the streets were carried across on their original alignments by reinforced-concrete structures. Problems in the design included cantilevering part of a parallel street over the depression. Problems in the construction included five temporary bridges to maintain traffic. These notes and illustrations are taken from a paper presented before the St. Louis Engineers' Club by S. L. Wonson, bridge engineer of the Missouri Pacific Railway, who described the work in detail from inception to completion.

THE CROSSINGS

The general location of the railways and streets is shown on the general plan. The two railroads cross Vandeventer Avenue on a large skew and Tower Grove Avenue approximately at right angles. Just west of the crossing the Oak Hill Branch of the Missouri Pacific branches off to the south and crosses the Frisco. An industrial spur from the Oak Hill line backs in across the two avenues south of the Frisco, and this spur is in turn crossed by two industrial spurs from the Frisco.

The crossings, which are near the western city limit, are typical as to development, in that the section was built up and the streets were opened up across the tracks long after the building of the railways. As the section developed the street traffic grew, until in 1909 it amounted to approximately 400 street cars, 2400 vehicles and 600 pedestrians in twenty-four hours. Passenger stations on both roads, at which practically all passenger trains stop, contributed largely to freedom from serious accidents, but at the same time increased the inconvenience and delay to street traffic by the necessity of trains occupying the crossings during stops.

EARLY ELIMINATION STUDIES

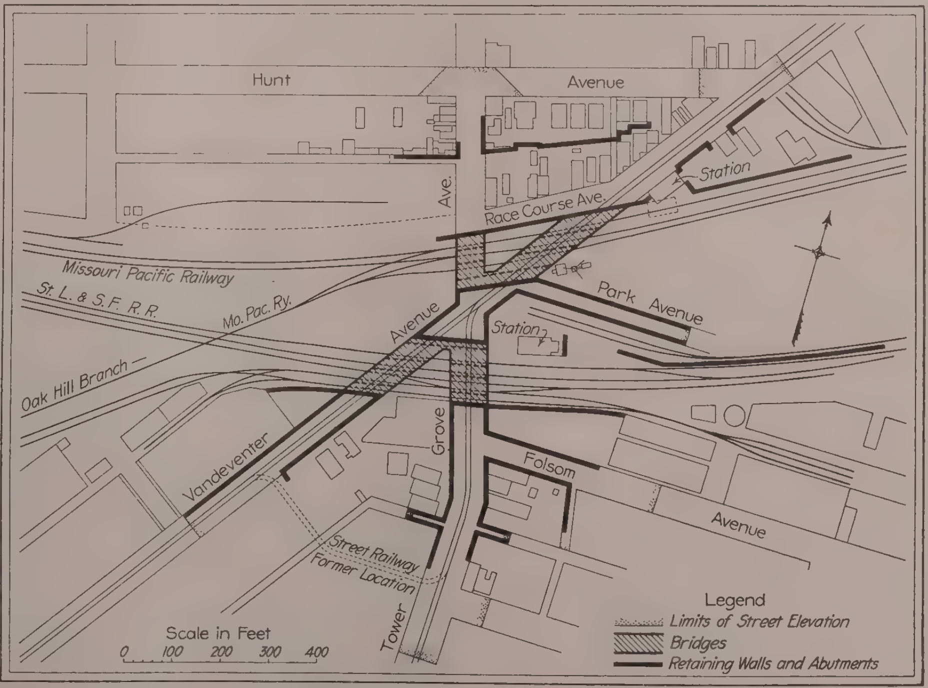
In 1905 the question of eliminating these crossings was first taken up on a basis of street depression, and in 1907 a plan was agreed upon providing for a long subway on the line of Tower Grove Avenue, parts of Vandeventer Avenue being closed. The estimated cost of this scheme was about $500,000.

Popular opposition to this scheme caused its final rejection, and in 1909 an ordinance was passed requiring the railroads to depress their tracks and leave the streets on their existing grades. This would have cost $3,000,000 and was successfully defeated by the railroads when carried to the State Supreme Court in 1912. In 1913 the cheaper plan was adopted of depressing the railroads 13 ft. and raising the streets a like amount.

PLAN ADOPTED

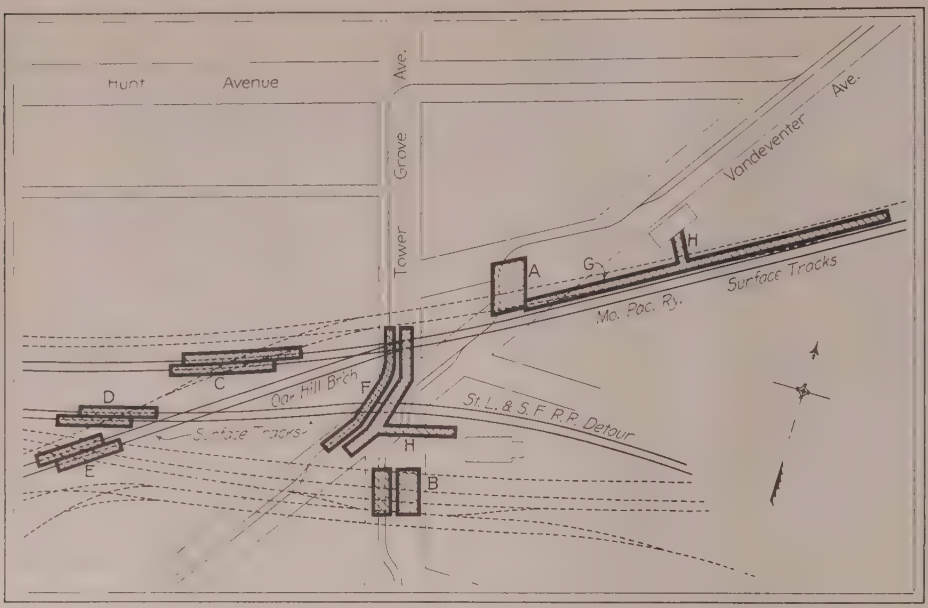
The general plan shows the scheme adopted. The bridge structures are of reinforced concrete, the bents being spaced to accommodate both present tracks and future proposed tracks. The approaches and the space between bridges are solid fill, held by retaining walls on the street line except at points where the properties themselves have been filled to the new level. The street grades are 3½ per cent.

Realizing that the service level of many lots and buildings would in the future be at the new street grade, and as the construction of retaining walls in such cases was an economic waste, the railways induced several of the property owners to raise their buildings and allow the railways to fill their property in. In general, however, the property owners preferred to



GENERAL PLAN OF IMPROVEMENTS—BRIDGES SHOWN CROSS-HATCHED

Note that the properties on Race Course Avenue have been raised and the retaining walls built behind the buildings.



VARIOUS TEMPORARY BRIDGES WERE REQUIRED DURING CONSTRUCTION

A. Vandeventer Avenue Bridge over Missouri-Pacific Cut. B. Tower Grove Avenue over Frisco Cut. C. Missouri-Pacific Bridge over Oak Hill Cut. D. Frisco Bridge over Oak Hill Cut. E. Oak Hill Bridge over Frisco Cut. F. Temporary High Level Bridge, Tower Grove Avenue. G. Temporary Platform. H. Temporary Footbridge. Temporary location of tracks, solid lines; ultimate, dotted.

await a definite adjustment with the city, which under the ordinance assumed the damages.

The new railroad profiles lower summits on both lines. The most unsatisfactory feature as to gradient was the necessity of introducing 2½ and 3-per cent grades to reach the industries south of the crossings. There is also a sharp but short dip in the profile of the Oak Hill branch to cross the Frisco at grade.

Bridges and Walls

The bridges are of concrete beam and slab deck construction. The bents have rectangular columns and footings spaced about 12 ft. on centers. The columns are joined at the tops by cross girders supporting the deck beams and at the feet by continuous diaphragms extending to 4 ft. above top of rail, these serving primarily as guards against damage to the bridge from derailed equipment. The footings of bents and abutments are designed for a maximum pressure of 2½ tons per square foot on the firm yellow clay found at this point, this figure having been adopted after a series of loading tests. On account of the skew of Vandeventer Avenue the deck beams there are built normal to the bents, and, with the deck slabs, are supported at the street lines by fascia girders from 26 to 72 ft. long, those more than 35 ft. being steel plate girders incased in concrete.

Gravity sections were used for the abutments of the Frisco bridges, while those and the connecting retaining walls of the Missouri Pacific bridges are of a reinforced counterfort type on the north side and a bent-and-slab design on the south side.

At Race Course Avenue requirements of street widths at the elevated level and track room at the depressed grade necessitated the use of cantilever brackets for supporting the sidewalk and concrete rail along the retaining wall between the two bridges. One of the drawings shows the construction. In order to avoid possible cracking of the sidewalk due to slight settlement of the street fill the portion of the sidewalk slab inside the wall was also designed as a cantilever. As the retaining wall and street line are not parallel the overhang of the sidewalk slab is variable throughout—a feature typifying a considerable absence in uniformity of construction imposed by local conditions throughout the entire work.

Supporting a 20-Inch Water Main

A 20-in. water main was supported under the west sidewalk of the Tower Grove Avenue bridges by ⅞-in. round U hangers 6 ft. apart, as shown in one of the illustrations. The ends of the hangers embedded in the sidewalk slab are of bronze to insure permanence, and sleeve nuts under the slab permit installation as well as adjustment and replacement of the main. Removable sections of the sidewalk slab provide access to the joints of the main for calking and repairs by breaking through the 2½-in. sidewalk finish.

Material changes were required in the Missouri Pacific station, which was raised and swung around parallel to the new street at the new grade. The Frisco station was underpinned and maintained without change in level or position.

The elimination ordinance provided that the construction cost, including the relocation of municipal sewers and water mains, should be assumed by the railways, and the damages to abutting property by the city. The expense of rearranging other utilities, such as street-car tracks, gas mains, conduits and wires, was assumed by the proprietary interests. No attempt was made by the ordinance to prescribe the division of cost between the railways. As they adjusted it between themselves, each assumed the rearrangement of its own facilities and there was a distinct division of the work on the basis of location except as to part of the work on the Missouri Pacific spur on the south side. Almost all of the Missouri Pacific work was done with its own forces. The Frisco performed its track depression and rearrangement with its own forces and the remainder of its work by contract.

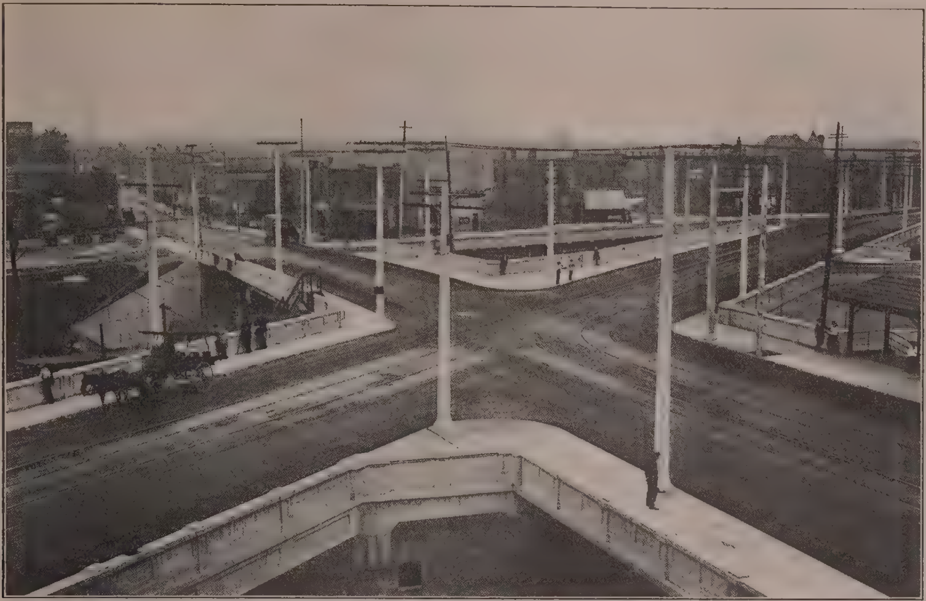
Maintaining Street Traffic

Owing to the considerable volume of street traffic and the absence of other crossings in the vicinity, it was necessary to provide for maintenance of street traffic throughout the construction. To avoid the expense of a temporary viaduct at one side the city permitted closing the two west legs of the X, the plan being to complete the elevation of these sections and turn street traffic over them, after which the remaining legs would be completed. This plan with minor changes was followed.

One of the illustrations illustrates the successive steps in making the Missouri Pacific track depression. The two main tracks were first thrown over to the south side of the right-of-way and a steam-shovel cut as wide as practicable along the north side was started from the west end of the depression, the shovel being carried on blocking through the deeper portion of the cut to permit loading on cars on a surface track. In the vicinity of the streets the cut was widened to include excavation for the bridge abutments and retaining walls along the north side of the tracks in order that the concrete work might be started.

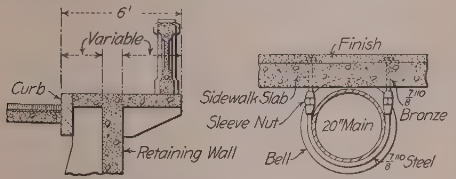
When the cut had been carried up to the

LOOKING NORTH PRIOR TO IMPROVEMENTS—FRISCO IN FOREGROUND



INTERSECTION OF AVENUES AS IT NOW APPEARS—NOTE OVERHANG OF RACE COURSE AVENUE IN BACKGROUND

street-car tracks in Vandeventer Avenue a wooden bridge was built behind the shovel to carry the street traffic over the excavation by a slight detour. The cut was then continued through the street and to the east end of the depression. East of the streets sufficient width could not be left between the operated surface tracks and the edge of the excavation for the proper accommodation of passengers and handling of baggage, and a temporary platform 500 ft. long was built along the track for this purpose, connecting with the station by a temporary footbridge.



CANTILEVER SIDEWALK, AND METHOD OF HANGING 20-INCH MAIN

A permanent track was then laid in the excavation and westbound traffic was transferred to it, the temporary bridge at Vandeventer Avenue being raised about 4 ft. to provide overhead clearance. This permitted removal of one of the two surface tracks, widening the excavation and construction of the second permanent track at the depressed level. The depression of the Oak Hill branch was performed in a similar manner. Most of the material for raising streets and private property was dumped from the dirt trains brought on a temporary track from the west end of the depression into Tower Grove, Race Course and Vandeventer Avenues.

The Frisco excavation was also made by steam shovels, but under somewhat less difficult operating conditions, as it was here possible to divert traffic on two temporary tracks largely clear of the excavated area. Part of the cutting beneath and between the bridges was handled very successfully by a Thew shovel loading on cars or into teams as conditions dictated.

One of the drawings shows the stage of the viaduct construction Dec. 1, 1914, when street traffic was transferred from the surface over the two east legs of the X to the high level over the two west legs, the gaps in the permanent work being closed by temporary wooden bridges. Prior to this change, as shown in another illustration, temporary bridges were in service for Vandeventer Avenue traffic over the Missouri Pacific cut, Tower Grove Avenue traffic over the Frisco cut, Missouri Pacific traffic over the Oak Hill cut, Frisco traffic over the Oak Hill cut and Oak Hill traffic over the Frisco cut.

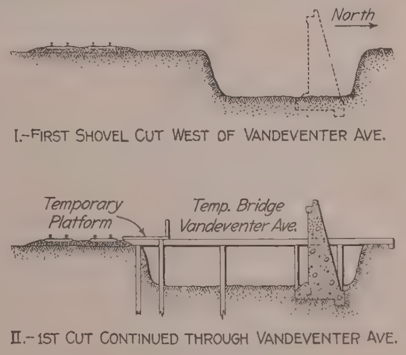
It had been intended to change all traffic to the depressed level and all highway traffic to the elevated level on the same day, but unforeseen delays and complications made it impossible to abandon all the surface tracks at this time. A temporary bridge, *F* on the drawing last mentioned, was therefore built to carry street traffic over the incomplete portion of Tower Grove Avenue north, and Vandeventer Avenue south, of the street intersection. To provide for clearance over the surface tracks used by the Oak Hill trains and the Frisco detour tracks this bridge was raised about 4 ft. above the permanent street grade with run-off on the completed concrete viaduct. After this change in street traffic a comparatively free opportunity was afforded for the remaining steps of the work. All railway traffic was removed from the surface in February, 1915, and on July 31 all streets were opened for travel.

The total cost of the improvement to the railways, city and public-utilities companies was $830,000. Owing to the conditions imposed upon both design and construction, the work required attention out of proportion to its magnitude. More than 200 drawings covering the permanent work as constructed were prepared by the Missouri Pacific alone.

The engineers in charge of the planning and execution of the work were as follows: For the city, E. R. Kinsey, president of the Board of Public Service, C. M. Talbert, director of streets and sewers, and L. R. Bowen, bridge engineer; for the St. Louis & San Francisco Railroad, F. G. Jonah, chief engineer, and Perry Topping, assistant engineer; for the Missouri Pacific Railway, C. E. Smith, formerly assistant chief engineer, during the later stage of construction E. A. Hadley, chief engineer, S. L. Wonson, bridge engineer, and W. D. Hudson, L. H. Davis and S. M. Bate, assistant engineers.

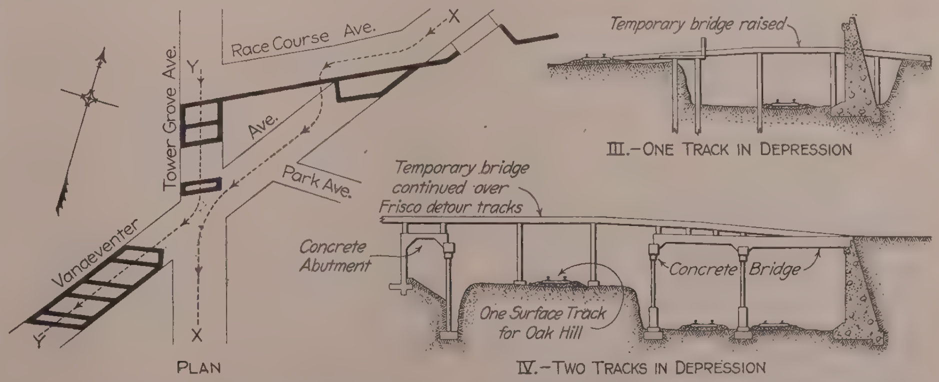
Longleaf Pine Not Inferior as Paving Block Material

A TYPOGRAPHICAL error in this journal's abstract of the report on paving, submitted to the Boston Finance Commission by Guy C. Emerson, consulting engineer, and published in the Engineering Record of Oct. 23, page 503, reverses the meaning of a sentence relating to wood block. The sentence, as printed, reads: "In some cases the longleaf yellow pine, an inferior wood, has been substituted for the shortleaf variety." The words longleaf and shortleaf should be interchanged, making the sentence, as it appeared originally in Mr. Emerson's report, as follows: "In some cases the shortleaf yellow pine, an inferior wood, has been substituted for the longleaf variety." Mr. Emerson has also informed this journal that his findings on wood-block paving are based entirely upon conditions in Boston.



I.–FIRST SHOVEL CUT WEST OF VANDEVENTER AVE.

II.–1ST CUT CONTINUED THROUGH VANDEVENTER AVE.



III.–ONE TRACK IN DEPRESSION

IV.–TWO TRACKS IN DEPRESSION

FOUR STAGES OF MISSOURI PACIFIC WORK—PLAN SHOWING SECTIONS OF PERMANENT BRIDGES IN PLACE WHEN STREET TRAFFIC WAS SHIFTED FROM LOW LEVEL *X—X* TO HIGH LEVEL *Y—Y*

Design of Turbine Draft Tubes Analyzed

Part II — Theory and Formulas Developed in Part I Applied to Typical Problem Embodying Practical Conditions

By A. G. HILLBERG
Hydraulic Engineer, New York City

THE CONVENIENCE of using the formulas in Part I in the design of draft tubes is demonstrated in the following problem. Given a 15,000-hp. wheel operating under a gross average head of 54 ft. The model of the runner has under test given a maximum efficiency of 88 per cent, and by means of the Camerer formula it has been estimated that the full-size wheel will in all probability give close to 90 per cent efficiency. The point of maximum efficiency on the curve has been located at 0.8 gate and the best speed determined accordingly. The turbine will be of the vertical type and it will drive a single-phase generator, which will furnish energy for traction purposes. Now

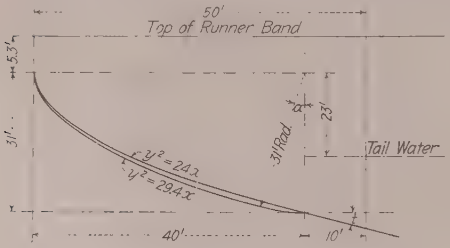


FIG. 6—ADJUSTED CENTER LINE OF TUBE

$$h_0 = 54 - (\sqrt{54}/3) = 51.5 \text{ ft.}$$

$$Q = \frac{15{,}000 \times 550}{62.5 \times 51.5 \times 0.9} = 2850 \text{ sec.-ft.}$$

$v_1 = 0.3$ to $0.4\ \sqrt{2g51.5} = 17.3$ to 23 ft. per second,

v_1 being velocity of flow through runner band. Suppose in this case the turbine manufacturer has stated that the design of his wheel is such that $v_1 = 20$ ft. per second.

$v_n = 0.05$ to $0.10\ \sqrt{2g51.5} = 2.9$ to 5.75 ft. per second.

Suppose the river channel at the power house, however, is narrow and comparatively deep even at the lowest stages of the river. Practically no tailrace, therefore, has to be excavated, so that the outflow velocity is assumed at 3 ft. per second.

DIFFERENCE IN ELEVATION

By means of equation 1 the difference in elevation between the top of the runner band and the lowest tail-water level can be determined. The equation read

$$E = 33.9 - (M - L) - (v^2/2g)$$

In this case the draft tube will be assumed an ordinary length justifying the use of a value of 3 for $(M - L)$, but the power will be used for traction purposes and thus the load variations will be severe. The term $(M - L)$, therefore, is assumed at 4.68. Therefore

$$E = 33.9 - 4.68 - 6.22 = 23.0 \text{ ft.}$$

The top area of the draft tube, that is at the runner band, is

$$A_1 = Q/v_1 = 2850/20 = 142.5 \text{ sq. ft.}$$

and the area at the outflow end is

$$A_n = Q/v_n = 2850/3 = 950 \text{ sq. ft.}$$

The top area, as explained previously, must be circular, and its diameter, therefore, is 13.46 ft. The end area can be of several shapes, and it is here assumed elliptical, as a circular area would require too much excavation both in the foundation and the tailrace, the horizontal axis is assumed twice the vertical. Consequently $\pi ab = 950$, and, since $2b = a$,

$$b = \sqrt{950/2\pi} = 12.3$$

The minor axis (vertical) is, therefore, 24.6 ft., while the major axis (horizontal) is 49.2 ft. Should it be found that this width is too great, the permissible width can be determined by means of the spacing of the units and the width of the concrete pier between the draft tubes required to carry the load safely. The calculation is then repeated backwards and the length of the minor axis determined. In this case it is assumed that the length of 49.2 ft. is satisfactory.

As the outflow velocity is small the highest point of the end area will be located 12 in. below the lowest tail-water level.

The distance from the center line of the unit to the downstream wall of the power house has been determined previously in connection with the design of the scroll case, and it is also dependent upon the amount of space required on the generator-room floor. In this case, because of a slight complication, it is assumed that this distance is 50 ft.

TWO POINTS ON CENTER LINE NOW KNOWN

The two points on the center line required in order to locate it are now known. Taking the lowest tail-water level as one axis and the center line of the wheel as the other, one point is at 0/23, while the other is at 50/13.3. The design of the turbine, however, is such that the bottom flange of the lower foundation ring is about 4 ft. lower than the runner band. It is, therefore, determined to begin curving the draft tube at a point 5.3 ft. below the runner band.

Looking at the diagram it is seen that the center line of the draft tube is too long. As the actual length 50 ft. cannot be changed, since this is determined from other requirements than those of the draft tube, the theoretical length is shortened to 40 ft. by building an arch 10 ft. wide inside the wall of the substructure. The intrados at the crown of this arch should project above ordinary stages of the water, and if possible above the highest water level, in order to effect the desired reduction in length of the draft tube. In many instances, however, tunnels located in the substructure, and in some cases the scroll case itself, prevent this arch from being carried as high as might be desired.

A parabolic center line will be used. In order to get as simple an equation as possible, the system of axes will have its origin at the apex of the parabola. The equation then reads $y^2 = ax$, and, as the center point of the end area must lie on this parabola, $y = 31$ when $x = 40$, or

$$a = (31)^2/40 = 24$$

making

$$y^2 = 24x$$

The center line can now be plotted. When this has been done it appears, that the angle between the tangent of the parabola and the horizontal is 21 deg. 10 min. This is too much, and an arc of a circle of 31-ft. radius is, therefore, inserted as shown in Fig. 6.

A new parabola must now be calculated, and it must have its apex at the origin and its branches must be tangents to this circle. As the equation of the circle is

$$(x - 40)^2 - y^2 = 961$$

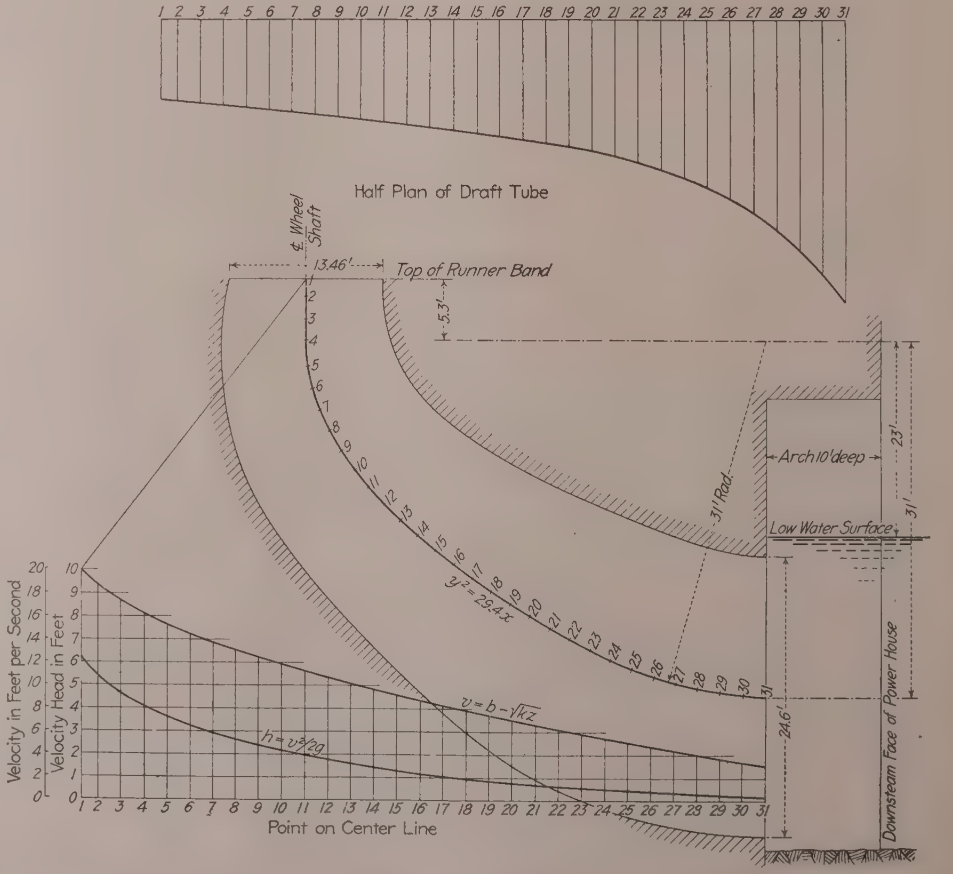


FIG. 7—SHAPE AND DIMENSIONS OF DRAFT TUBE FULLY WORKED OUT

the equation of the new parabola becomes

$$y^2 = 29.4x$$

The true center line can now be plotted. The subtended angle α of the arc is 28 deg. 20 min.

LENGTH OF CENTER LINE

In figuring the true length of the center line it must be borne in mind that two different curves must be considered, one a parabola and the other an arc of a circle. The length of the arc is

$$\frac{\pi r \alpha}{180} = \frac{\pi \times 31 \times 28.33}{180} = 15.3 \text{ ft.}$$

The length of the arc of the parabola can be determined by the formula

$$S = \int_{x=0}^{x=y^2/a} \sqrt{1+\left(\frac{dy}{dx}\right)^2}\, dy$$

so that

$$S = 38.9 \text{ ft.}$$

The total length of the center line, therefore, is

$$5.3 + 38.9 + 15.3 = 59.5 \text{ ft.}$$

Instead of the length of the center line being calculated it can be plotted to a large scale and measured with sufficient accuracy.

In determining the shape of the draft tube the areas should be calculated at points spaced from 2 to 3 ft. apart. As neither of these spacings multiplied by a certain number will equal the length 59.5, the first space will be made to suit. In this case a 2-ft. spacing will be used and the first space will, therefore, be 1.5 ft.

VELOCITIES

Previously it has been determined that $v_1 = 20$ and $v_n = 3$ ft. per second, and now it is also known that $l = 59.5$ ft. Equation 11 consequently becomes

$$v = 23 - 2.57\sqrt{z}$$

In locating v_1 and v_n equations 12 and 13 are used; thus

$$z_1 = 1.37$$

and

$$z_n = 59.5 + 1.37 = 60.87$$

A table is now established giving the values of the different elements of the draft tube. Such a table is given herewith in abbreviated form.

The time required for a drop of water to pass through the tube can be determined by equation 14. In this case $\sqrt{k} = 2.57$, $z_n = 60.87$ and $z_1 = 1.37$, so that

$$t = \frac{2}{2.57}(\sqrt{60.87} - \sqrt{1.37})$$

$$= \frac{2 \times 6.63}{2.57} = 5.16 \text{ sec.}$$

The volume of the draft tube is calculated by means of equation 17. In this case $b = v_1 + v_n = 20 + 3 = 23$; $\sqrt{k} = 2.57$ and $Q = 2850$, so that

$$\sqrt{k}/b = 2.57/23 = 0.112$$

$$z_n = 60.87$$

and

$$z_1 = 1.37$$

so that

$$(\sqrt{z_n} - \sqrt{z_1}) \text{ as before} = 6.63$$

Hence

$$m = 1 - 0.112 \times 6.63 = 0.257$$

and

$$\ln m = \ln 0.257 = -1.357$$

Therefore

$$V = \frac{2 \times 2850 \times 23}{(2.57)^2}(0.257 + 1.357)$$

$$= 32{,}100 \text{ cu. ft.}$$

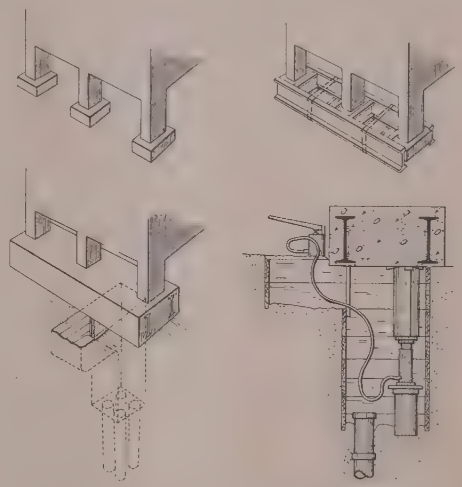
VALUES OF DIFFERENT ELEMENTS IN DRAFT TUBE DESIGN

Point on Center Line	Dist. from Upper End of Draft Tube, Ft.	z, Ft.	v, Ft. Sec.	$v^2/2g$, Ft.	$\frac{v_a^2}{2g} - \frac{v_{a+1}^2}{2g}$ Ft.	h, Ft.	$h_{a+1} - h_a$, Ft.	Area, Sq. Ft.	Remarks
1	0	1.37	20.00	6.22		0		142.5	Circle, $D = 13.46$
					0.82		1.5		
2	1.5	2.87	18.65	5.40		1.5		152.8	Circle, $D = 13.97$
					0.74		2.0		
3	3.5	4.87	17.33	4.66		3.5		164.4	Circle, $D = 14.49$
					0.54		2.0		
4	5.5	6.87	16.27	4.12		5.5		175.2	Circle, $D = 14.93$
					0.46		2.0		
5	7.5	8.87	15.35	3.66		7.5		185.7	Circle, $D = 15.38$
					1.48		9.0		
10	17.5	18.87	11.83	2.18		16.5		240.8	Circle, $D = 17.53$
					0.87		7.0		
15	27.5	28.87	9.20	1.31		23.5		309.6	Circle, $D = 19.86$
					0.555		5.8		
20	37.5	38.87	6.98	0.755		29.3		408.0	Circle, $D = 22.80$
					0.360		4.7		
25	47.5	48.87	5.05	0.395		34.0		564.0	Ellipse, $a = 12.3$; $b = 14.6$
					0.226		2.24		
30	57.5	58.87	3.30	0.169		36.24		864.0	Ellipse, $a = 12.3$; $b = 22.4$
					0.029		0.06		
31	59.5	60.87	3.00	0.140		36.30		950.0	Ellipse, $a = 12.3$; $b = 24.6$

Note: The dimensions a and b of the elliptically shaped areas are half the length of the minor and major axes of the ellipses.

Soil Tests Reported and Safe Underpinning Methods in Sand Described

Excavation for New York Subway in William Street Encounters Sandy Soil Which Forces Adoption of Special Precautions



SUCCESSIVE STEPS IN UNDERPINNING A TYPICAL THREE-PIER BUILDING

AFTER the first eight months of underpinning operations, during which more than sixty buildings have been successfully supported on William Street for the New York subway excavation in sandy soil, which the property owners had considered so unsafe that they had protested to the courts, the methods of work and precautions taken have demonstrated the possibilities of carefulness and system without the adoption of elaborate or expensive schemes. In an article entitled "Meeting the Soil Halfway on William Street" in the September issue of the *Public Service Record*, John F. Greathead, assistant engineer, has described the tests made and principal methods used on this work. Following is an abstract of the article:

RIGID RULES FOLLOWED

In order to place the underpinning operations on the plane of known facts instead of chance, the following rules have been adopted: (1) To insure *permanent* support, all building foundations are to be extended below the influence of subway excavation—that is, for adjacent buildings—to well below subgrade; (2) to insure *adequate* support, every pile driven is to be actually tested to from 1½ to 2 times the assigned load, and the area of spread foundations is to be based on tests.

The various tests were made under the direction of the Public Service Commission, and the exact nature of the soil was noted in every case. Soil samples, varying from almost pure clay through various graded mixtures of clay and sand to almost pure sand, were numbered from 1 to 10 and analyzed as to constituents and fineness. After an unsuccessful attempt to use dry separation by the No. 100 sieve as a dividing line between sand and clay, a volumetric separation by shaking with water, permitting the sand to precipitate first, has been determined upon as the closest to truth of any easily performed test. The character of the ground exposed during underpinning is constantly compared, either by eye or by the water test, with a set of the standard samples.

METHODS OF TESTING—GENERAL RESULTS

The first experiment, to determine the greatest imposed load a certain sand would safely stand without undue or progressive settlement, was made by the use of a triangular test platform, of 12-ft. lengths of 12-in. I-beams, resting at each corner on a 12 x 12-in. vertical timber whose end bearing on the soil was 1 sq. ft. Test loads were then applied, varying from 2 to 8 tons per square foot, and sustained at various intensities for periods up to one week in length. Levels taken on spikes driven in the platform legs indicated the settlement during loading and also the often equally great settlement under a steady load during the time interval.

Unequal settlement at the three corners was observed, probably due to the fact that the bags were swung with some impact at the corner which showed the greatest settlement. The average total settlement at 4 tons per square foot for sand containing 3 per cent clay was ⅜ in.

This test was criticised not only because of the method of loading, but because of the small area of each bearing surface. Accordingly, 4 sq. ft. of bearing area were forced into a similar soil (with 12 per cent clay, however) by successive increments of load from a hydraulic jack. The settlements were more uniform, but otherwise the results corroborated the preceding tests, the settlement being less than ½ in. at 4 tons per square foot.

STEEL-JACKETED PILES

The weapon which has conquered the William Street soil is undoubtedly the 14-in. hollow boiler-plate shell, jacked to the desired depth, cleaned out and concreted. No one would attempt to sink a 4 x 4-ft. foundation pit below ground water in sand. By careful trenching and screened pumping from sumps, the contractor in many cases lowered the ground water, and therefore the pits, many feet. All but the easiest cases, however, required the use of piles.

The diagrams on page 631 show the typical underpinning method in which piles are used under a three-pier foundation in the front of a building. Two I-beams (or lattice girders) are clamped around the outer and inner sides of the foundation slabs and bound together by heavy cables between the piers. The transverse faces of the slabs are also fitted into channels or I-beams whose ends rest above or upon the longitudinal beams. When the whole is concreted solid it forms a substantial grillage.

A pit is then started between the piers, and is carefully sheeted horizontally when large enough to admit a man. This pit is deepened and kept closely sheeted until ground water makes further progress impossible. A 2-ft. cylinder, the first length of a 14-in. pile, is then stood on the pit bottom and jacked down by an hydraulic jack as shown. When completely driven another length is added and the jack load reapplied. The material in the pile is removed by a miniature orange-peel bucket, a helical screw or other simple method.

TESTS OF PILES AND STEEL JACKETS

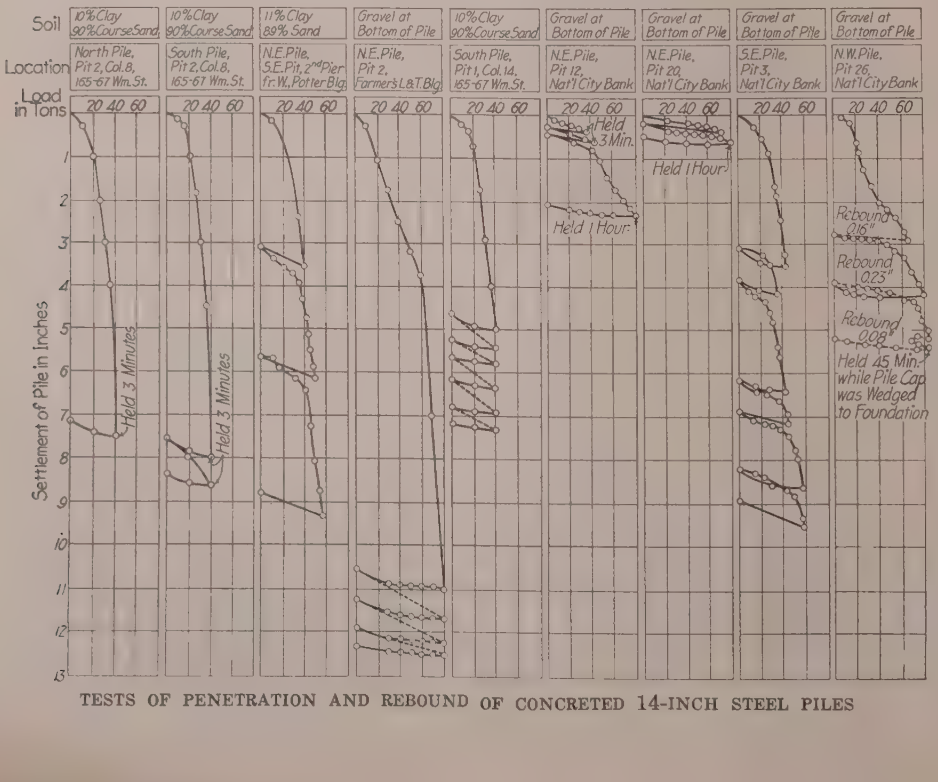
While still newly poured with concrete, each of the piles is tested with an hydraulic jack to a load at least 50 per cent greater than that apportioned to it, being jacked down, if necessary, until it will carry that load with no settlement for a period of observation ordered by the engineer.

A very important operation for minimizing the later settlement of the building then ensues. A column of steel shapes is erected upon each pile and powerfully wedged against the grillage with slender steel wedges. Thus part of the load is immediately transferred to the piles at a time when their settlement will not affect the building, and subsidence due to shrinkage or voids in the pit concrete is also provided against. The pit is now concreted, and in every case grout is introduced under about a 4-ft. head to take up the shrinkage of the concrete and especially to fill all voids, however small, around the old foundation and the new pit.

These pile lengths, although made of only ⅛-in. sheet metal, are very strong, the bearing and driving fit at the joint (2-in. inner lap, outside band) being especially close. An empty length of 14-in. piling supported a total test load of 89 tons with no effect other than a 4-in. farther penetration. In the loosest and coarsest sand available a 2-ft. length, started empty, carried 9½ tons when jacked flush with the ground. When filled with compacted sand and then jacked into the same soil it carried 40 tons, which was maintained for 5 min. This astonishing test was repeated under a near-by building with the same results. Lateral tests of the joint showed similar astonishing strength for this type of pile.

BULB OF SOIL PRESSURE

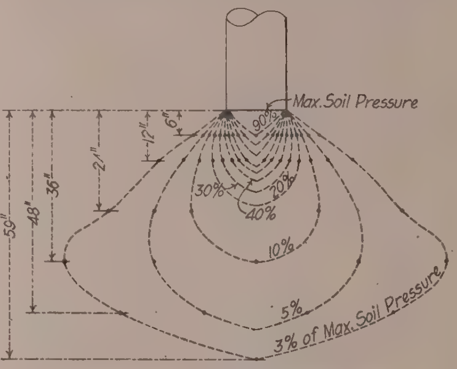
The area of the bottom of a 14-in. pile is about 1 sq. ft., and, furthermore, tests to be mentioned show the value of skin friction with these non-tapering piles to be slight, say 5 per cent. In view of the fact that sand, especially quicksand, is not allowed more than a few tons load for this unit area, it certain would be valuable if we could understand just how 80 tons are regularly supported without settlement during routing tests, and half that in actual practice under real building loads.



TESTS OF PENETRATION AND REBOUND OF CONCRETED 14-INCH STEEL PILES

The results of careful experiments with brown building sand to determine the "distribution of vertical soil pressure" conducted at Pennsylvania State College (see the Engineering Record of March 13, 1915, page 330) have been plotted in an entirely new way in the diagram herewith. Here we have visualized the cone, or more properly bulb, of resistant soil which forms below the base of the pile, radiating the pressures, with diminishing intensities (whose boundaries are shown), in all directions to the limit where no effect is produced by the load.

If the material had been confined water the highly compressed portion under the pile would naturally have freely moved away, so that there would have been no limit to the penetration of the pile. With the dry sand represented by the diagram, the pile increases the interior friction of the sand in direct ratio as the load is made larger; and the point arrives where lateral flow of material stops because of this friction. Beyond that the soil compresses until it will stand the pressure required by its relative position from the pile; then the pile no longer sinks under that particular load. It seems obvious that the more liquid the soil, and the greater the clay lubricant, the greater the necessary penetration should be, other things being equal.



DISTRIBUTION OF SOIL PRESSURE

Nine actual records of the way piles act under final tests are shown in the accompanying diagram. The loads were read from the pressure gage of the hydraulic pump, and the settlement was measured directly from the pile head to a stretched horizontal string, or by attaching the tape of a deflectometer. All of the curves show the rebound which occurs whenever the load is released. This distance, about ⅜ in., is nearly double the amount due to the elasticity of the pile; the balance must be due to the expansion of the compressed soil below.

WIDE PILE CAP—REDUCTION OF SETTLEMENT

A great forward step has been taken by the introduction of wide plates between the jack and the pile. When the official test to about double the actual dead load is completed, the pressure is held until steel beams are cut (with blowpipe) and wedged from the plates to the grillage of the building, on both sides of the jack, which is then released and removed. This results in a reduction of the rebound to from 0.23 to 0.08 in., as shown by curves for pile 9, clearly indicating that at least half of the 80-ton test load was permanently maintained on the pile below. As this is more than the assigned loads, no future settlement at all is anticipated.

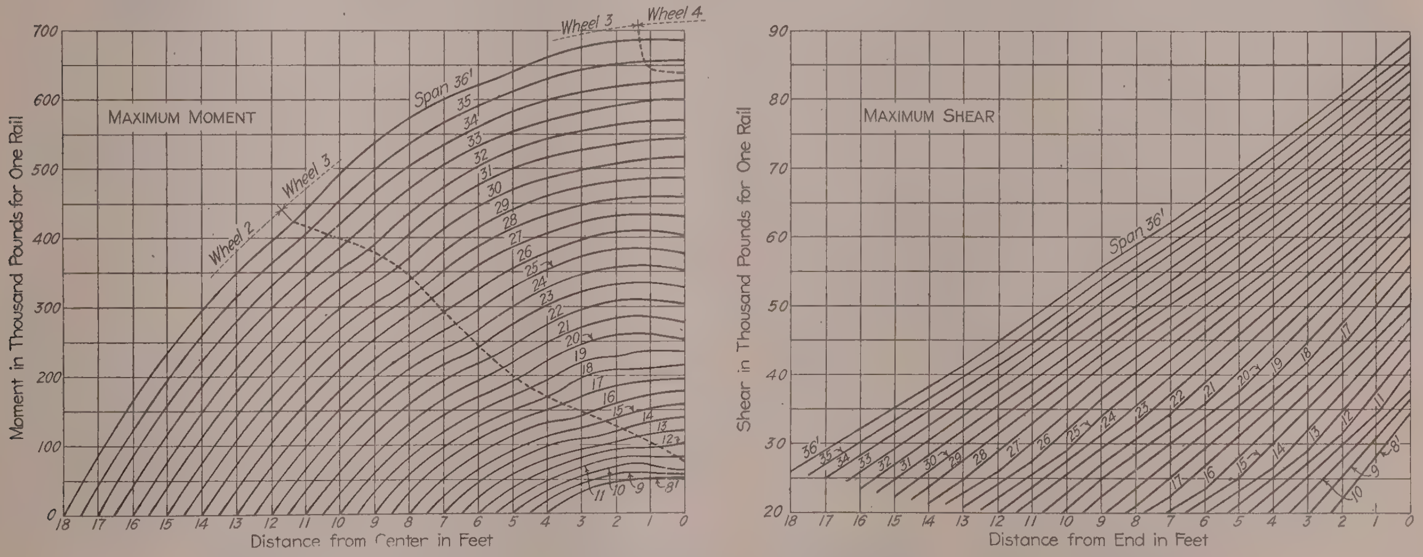
Just enough has been done in the direction of determining the skin friction of the 14-in. piles to discover the limiting values, and especially the difficulty of accuracy. In the first place, pressure gages capable of recording 100-ton loads on the pile are not very reliable for 5 tons. Also, the amount of muck left in the bottom of the pile is of primary importance. If muck is removed below the bottom of the casing, apparently voids occur at the sides, as little or no recorded pressure is required to sink the shell. It seems at this stage of the tests as though only from 4 to 6 tons of the 40 to 80 tons obtained from a 15-ft. length of pile are due to skin friction; that is, from 5 to 15 per cent. This corresponds to from 150 to 250 lb. per square foot of shell surface.

The contractor on this work is Smith, Hauser & MacIsaac, Inc. The various tests for the Public Service Commission are generally under the direction of Edmund A. Prentis, Jr. Lazarus White is the contractor's engineer, and proposed the wide pile cap and wedging method for preventing settlement.

Maximum E-50 Shears and Moments at Points of Short Beams

By W. M. ELIOT
Dallas, Texas

MAXIMUM shears and bending moments at intermediate points of beams from 8 ft. to 36 ft. in span length due to Cooper's E-50 engine loading may be obtained from the accompanying diagrams. For other Cooper's loadings proportional vertical scales can be made to give results directly, or the usual method of ratios applied.



MAXIMUM E-50 SHEARS AND BENDING MOMENTS AT INTERMEDIATE POINTS OF SHORT BEAMS

The diagrams are particularly useful in the design of reinforced-concrete beams or girders, for which not only the absolute maximum shear and bending is desired, but also the values at intermediate points for the purpose of designing the reinforcement.

STANDING TIMBER TOTALING 100,000,000 ft. b.m. is offered for sale by the U. S. Forest Service on the Plumas National Forest, California. About 60 per cent of the timber is estimated to be sugar and yellow pine. Fifteen years is allowed for cutting and removal, with additional time for necessary improvements. Payment is to be made in installments as the timber is cut.

Offer Preliminary Suggestions on Graphic Presentation

Committee Representing National Associations Created at Instigation of Mechanical Engineers Gives Seventeen Principles

SEVENTEEN fundamental principles are set forth in a preliminary report, just issued, of the Joint Committee on Standards for Graphic Presentation, a body representing various National organizations, and created at the instigation of the American Society of Mechanical Engineers. Willard C. Brinton of the latter society is chairman and Leonard P. Ayres, 130 East Twenty-second Street, New York City, secretary. The seventeen suggested principles, which in the report are illustrated, are as follows:

Generalities

1. The general arrangement of a diagram should proceed from left to right.

2. Where possible represent quantities by linear magnitudes, as areas or volumes are more likely to be misinterpreted.

3. For a curve the vertical scale, whenever practicable, should be so selected that the zero line will appear on the diagram.

4. If the zero line of the vertical will not normally appear on the curved diagram, the zero line should be shown by the use of a horizontal break in the diagram.

Which Lines to Emphasize

5. The zero lines of the scale by curves should be sharply distinguished from the other co-ordinate lines. (In the three illustrations in the report, one has a heavy horizontal zero line, at the base, representing zero population, the vertical graduations, representing years, having no zero; the second has both the left-hand vertical and the bottom horizontal lines heavy, representing zero in each case, while in the third, where the horizontal graduations indicate gain or loss, the heavy zero line is near the middle of the diagram.)

6. For curves having a scale representing percentages, it is usually desirable to emphasize in some distinctive way the 100 per cent line or other line used as a basis of comparison. (In the illustration shown the 100 per cent line, like the zero line, is shown heavy wherever it may come.)

7. When the scale of a diagram refers to dates, and the period represented is not a complete unit, it is better not to emphasize the first and last ordinates, since such a diagram does not represent the beginning or end of time.

8. When curves are drawn on logarithmic co-ordinates, the limiting lines of the diagram should each be at some power of ten on the logarithmic scales.

9. It is advisable not to show any more co-ordinate lines than necessary to guide the eye in reading the diagram. (Two contrasting diagrams for the same curve show the confusion caused by too many co-ordinate lines.)

10. The curve lines of a diagram should be sharply distinguished from the ruling.

Auxiliary Information

11. In curves representing a series of observations, it is advisable, whenever possible, to indicate clearly on the diagram all the points representing the separate observations.

12. The horizontal scale for curves should usually read from left to right, and the vertical scale from bottom to top.

13. Figures for the scales of a diagram should be placed at the left and at the bottom or along the respective axes. (In one of the illustrations shown the axes intersect in the center of the diagram, and the figures, therefore, come within the diagram.)

14. It is often desirable to include in the diagram the numerical data of formulas represented. (In illustrations given, quantities are shown at the top of the diagram, opposite the vertical lines, the lines being time graduations, so indicated at the bottom. Illustrating the inclusion in the diagram of formulas represented, in one of the diagrams the equation is written along the curve.)

15. If numerical data are not included in the diagram it is desirable to give the data in tabular form accompanying the diagram.

16. All lettering and all figures on a diagram should be placed so as to be easily read from the base as the bottom, or from the right-hand edge of the diagram as the bottom.

17. The title of a diagram should be made as clear and complete as possible. Subtitles or descriptions should be added if necessary to insure clearness.

THE TWIN PEAKS TUNNEL IN SAN FRANCISCO, the city engineer reports, will be completed within the next two years.

St. Louis Municipal Bridge East Approach a Steel Viaduct Nearly 3 Miles Long

Economy Results from the Use of Rolled I-Beams and Longitudinal Girders as Trolley-Rail Stringers—Expansion Joint Details

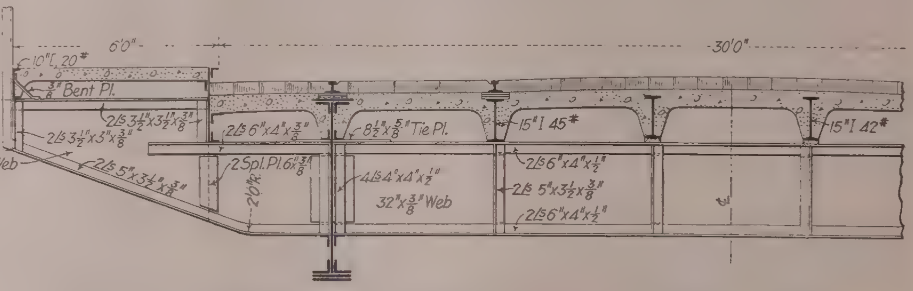
After considerable delay, the city of St. Louis authorized the bonds last November and recently let the contract for the east approach to the Municipal bridge, the three main spans of which have stood idle since their completion about 1910. These spans of 668 ft., the longest simple spans in the world, were described in the Engineering Record of Oct. 30, 1909, page 487, and of Dec. 31, 1910, page 641. In spite of local disputes between the labor unions and consequent delays, although the city of St. Louis itself is erecting the steel with union labor, it is expected that the approaches can be completed and the bridge opened for traffic by October, 1916.

The east approach is a steel viaduct nearly 3 miles long, and of three varying types of construction—a typical double-track railroad viaduct about 2 miles long, an independent highway viaduct more than ½ mile long, and a combination railroad and highway nearly ½ mile long. The construction here described includes sections of the combination type and of the highway viaduct, details of the expansion joints and bracing, economy in floor design and details of trolley-pole connections and bracing.

General Dimensions

The typical girder and tower spans are 75 ft. and 45 ft. respectively, fixed by the economical length of 15 ft. for the stringers in the highway floor, kept constant throughout for all structures carrying highway loading. In addition to the regular tower and girder construction there are four long spans, of which one is 296 ft. and one 276 ft. long. The total length of the viaduct is 13,300 ft.; the first 2300 ft. is a combined highway and railroad structure, the highway viaduct then diverges to the northeast for 3000 ft. to East St. Louis, and the railroad viaduct continues nearly eastward for 11,000 ft.

The details of the design provide for the future addition of four turnouts from the viaduct now to be built—one to the north for connection with the Pennsylvania lines, and three others toward the south to connect with various other railroads.



INTERMEDIATE FLOORBEAM AND CANTILEVER BRACKET ON HIGHWAY VIADUCT

Combination Viaduct

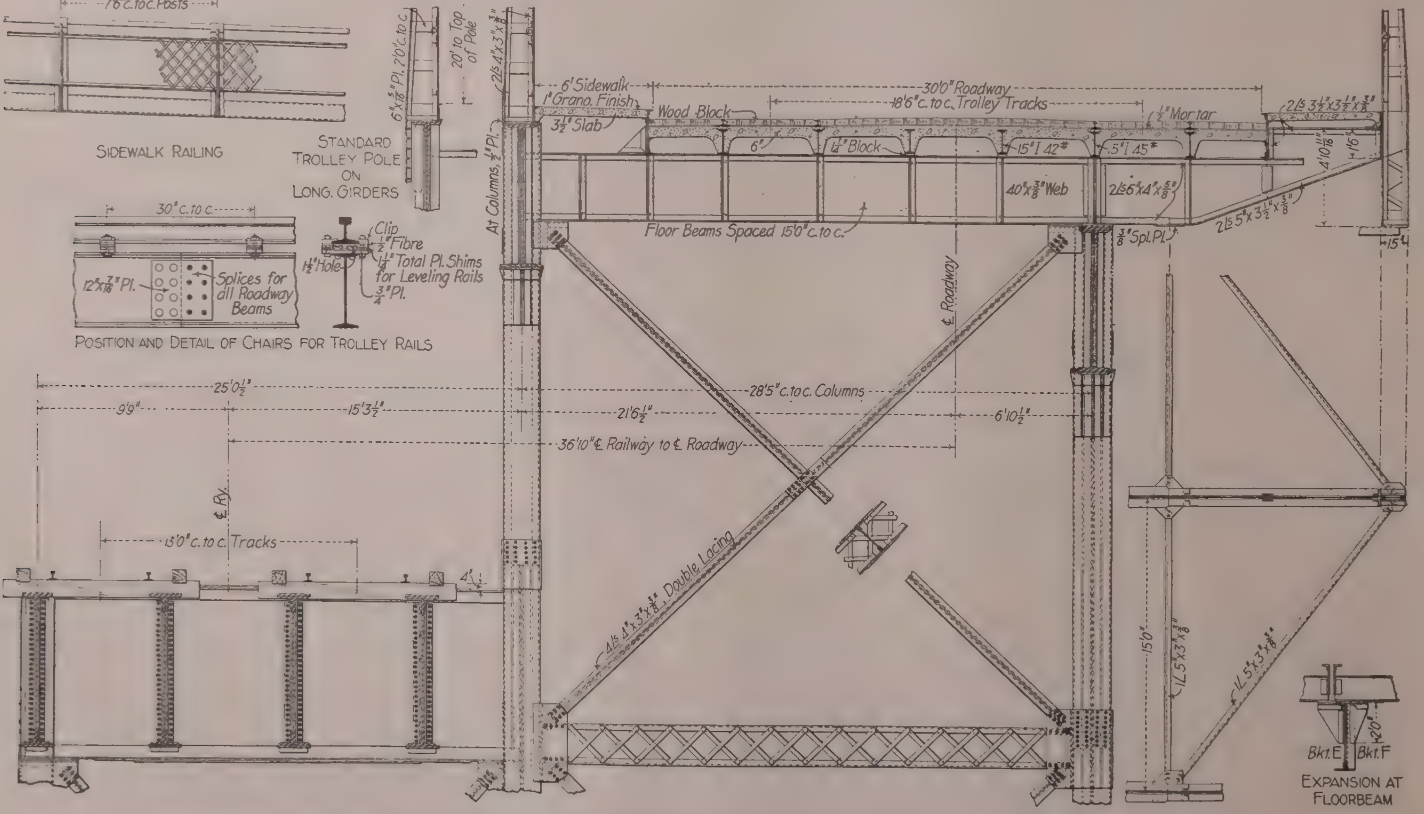
The accompanying cross-section shows the typical details and general dimensions of the combination viaduct. The location of the column on the right fixed the length of the overhanging ends of the floorbeams, and was decided by the desire to keep the loading on the two columns approximately the same. Note that the highway floorbeams are all spaced 15 ft. apart, and one end frames into, while the other end rests upon, a longitudinal girder.

Details of the expansion joint for the 15-in. I-beam stringers and of the supporting chairs for the trolley rails should be noted, also the manner of bracing the built-up trolley poles and connecting them to the floorbeams on one side and to the longitudinal girders on the other, as shown in the drawing. An unusual and effective detail for the lacing of diagonal bracing at the spliced intersection is worthy of mention.

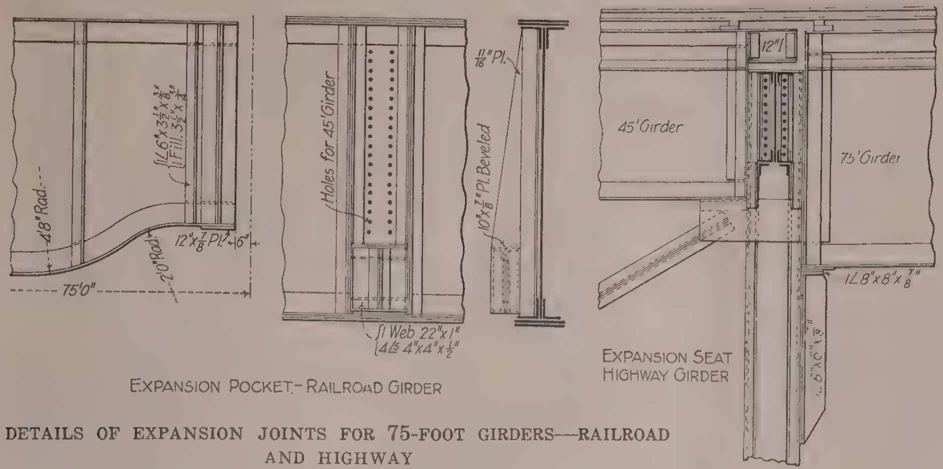
Highway Viaduct

In addition to the large economy effected by the use of rolled I-beam stringers for the roadway throughout, fixing the intermediate floorbeam spacing at 15 ft., added economy in design was accomplished by the scheme shown in the cross-section of the highway viaduct, where the main longitudinal girders are spaced to serve as outer trolley-track stringers. The sidewalks and part of the roadway are thus carried as cantilever loads outside of these girders on the brackets shown.

The expansion joints for the railroad girders, which occur in every 75-ft. span, are detailed with the deeper 75-ft. girders reduced to the same depth as the 45-ft. girders by curving the lower flanges, as in-



CROSS-SECTION AND DETAILS OF COMBINED RAILROAD AND HIGHWAY VIADUCT OF ST. LOUIS BRIDGE APPROACH



DETAILS OF EXPANSION JOINTS FOR 75-FOOT GIRDERS—RAILROAD AND HIGHWAY

dicated, and carrying them in expansion pockets. The 75-ft. highway girders, however, are supported on brackets on the columns without decreasing the end depth. A tieplate passes through a slot in the web of the longitudinal girder to take the top flange tension produced by the cantilever bracket.

The east approach will contain about 24,000 tons of steel and 35,000 cu. yd. of concrete. The contractor is the American Bridge Company. The designers are Boller, Hodge & Baird, consulting engineers, New York City. Erection is proceeding by city forces under the direction of C. H. Fisk, engineer of construction for the Board of Public Service of St. Louis.

Unit Construction Reduces Quantity of Concrete

J. E. Conzelman Proposes Use of Standardized Railroad Structures and Development of Shop Methods for Concrete

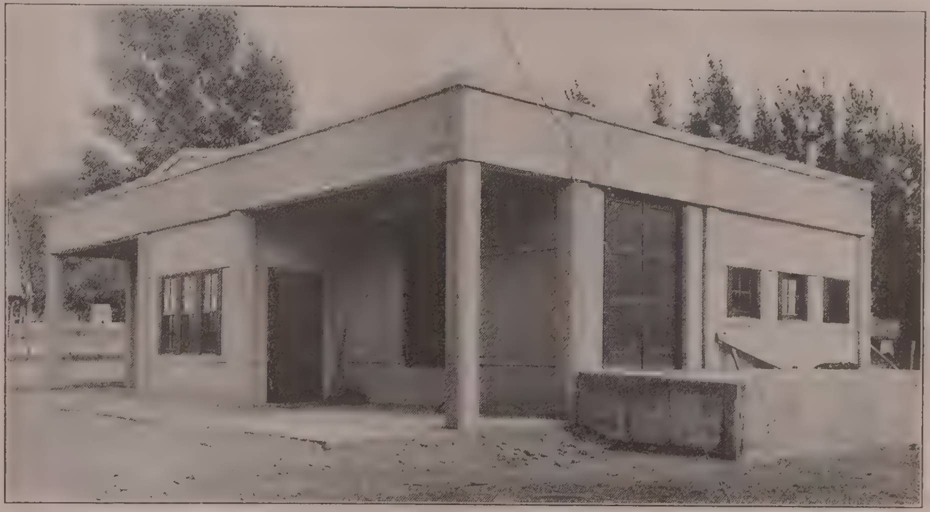
THAT UNIT METHODS of reinforced-concrete construction have proved their practicability during the last six years is claimed by J. E. Conzelman, vice-president and chief engineer of the Unit Construction Company, in a paper entitled, "Recent Application of Unit Methods to Reinforced Concrete Construction," presented before the Engineers' Club of St. Louis, Sept. 22. He states that under conditions favorable to its use unit construction has proved itself greatly superior to the usual or monolithic type, and its adoption has resulted in economy, simplicity of construction, and an opportunity for better workmanship.

Two large unit operations were used for illustration — the Cedar Rapids Power Company plant described in the Engineering Record of July 25, 1914, page 107, and the cotton-handling plant of the Galveston Compress & Warehouse Company, described in the Engineering Record of June 27, 1914, page 740. The following extracts from the address relate to standardized railroad structures and to the relative advantages of unit methods, with criticisms of some of the methods used in monolithic construction.

RAILROAD STRUCTURES COULD BE STANDARDIZED

Railroad work, according to Mr. Conzelman, offers a field for the development of the unit idea. A standardization of such structures as engine houses, freight sheds, snow sheds and track shelters could be made to result, he believes, in great economies by the adoption of this method. Centrally located factories should be established for the manufacture of the units. The amount of work that could be accomplished in this line by a small force working regularly would be surprising, and the cost, if permanent forms were used, would be exceedingly low. The accompanying photographs show typical examples of railroad structures built by the unit method.

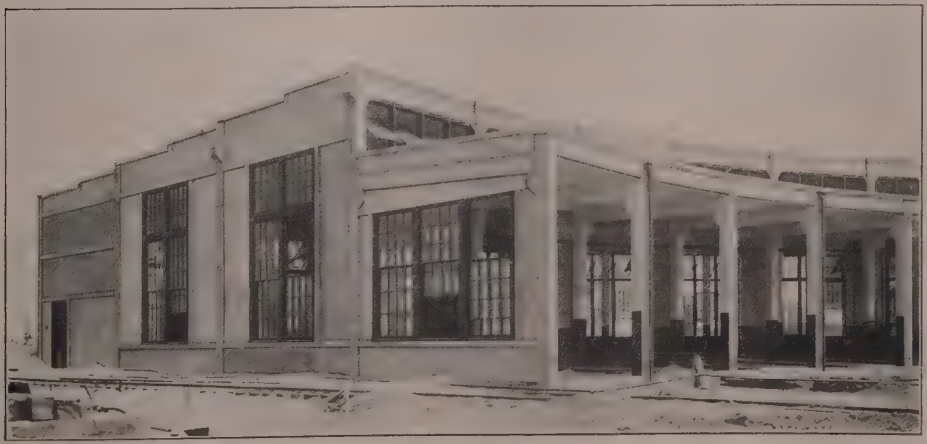
Shop fabrication would also permit the use of lighter sections, because factory concrete, it is claimed, has greater strength and is a more reliable product than the field mixed concrete of ordinary construction. By careful methods there is no doubt in Mr. Conzelman's mind that a large percentage of the concrete ordinarily used could be saved. Buildings would be carried in stock, as are other commodities, and could be "wrapped up" and sent out on short notice and erected in surprisingly quick time. What is true of railroad structures applies with equal force to any development consisting of similar units, such as terminal buildings or manufacturing centers.



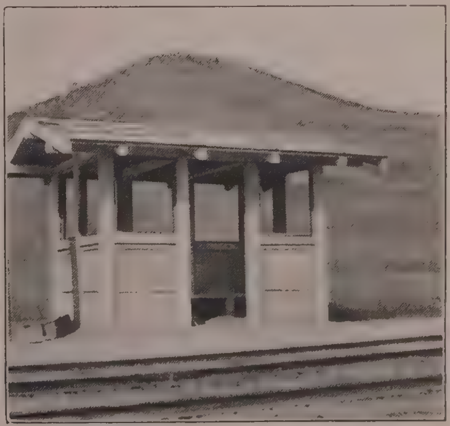
COMBINATION RAILWAY STATION AND FREIGHT HOUSE WITH HIGH PLATFORM

MASS CONCRETE MIXED TOO FAST

One of the phases of usual construction methods that needs correction is the haste with which the concrete materials are put through the mixer. Engineers, as well as contractors, seem to be hypnotized by the



SANTA FÉ ROUNDHOUSE CONTAINS PROVISIONS FOR FUTURE EXTENSION

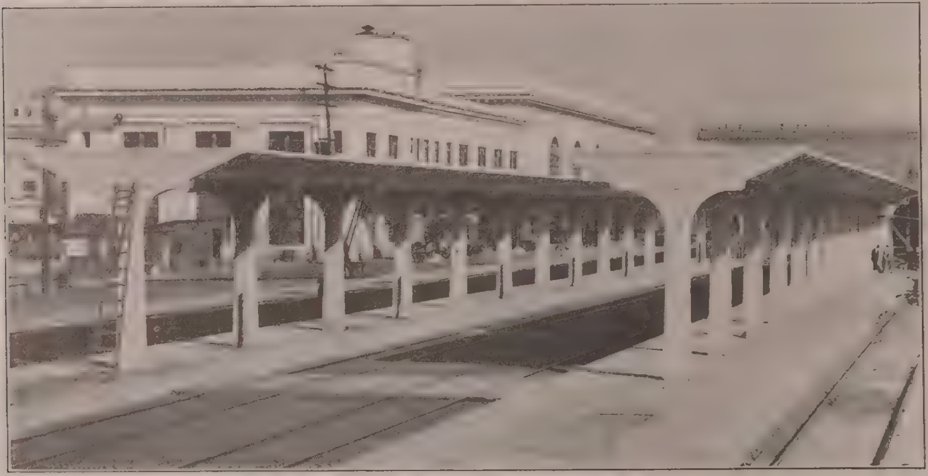


SHELTER HOUSE FOR ELECTRIC RAILWAY

American habit of doing things on a large scale and in the shortest possible time, and perhaps without due regard to excellence and uniformity of product. We want a batch a minute, a floor a week, ten floors in ten weeks, and arrange our plans accordingly. It was recently reported in one of the engineering journals that on a large contract an average of 70 batches an hour was frequently maintained. Can the materials for a yard of concrete develop the close intimacy necessary for a uniformly strong concrete in the 10 or 20 sec. they are allowed after their introduction into the mixer?

Waste of Concrete Materials

The result of these methods is the production of a concrete of mediocre strength and of uncertain quality. As a consequence it follows that more concrete materials are required than would be used if the materials were properly mixed. Recent experiments show that the strength of concrete can be greatly increased by long and thorough mixing, and it is no doubt true that better construction methods would result in a saving of as much as 20 per cent of the concrete materials without reduction in strength.



BUTTERFLY SHEDS AT LOS ANGELES DEPOT SHELTER TRACK PLATFORMS

A part of this trouble is due to the methods necessarily used in the construction of the ordinary concrete building. After a week or two of carpenter work the forms for one floor are prepared, then all energies are bent to pour the entire floor in one day of concreting. The mixer works about one day out of six and has to do the mixing in one-sixth of the time that should be allowed.

Unit methods are said to give opportunities for making better concrete. A reasonable amount is poured, each day which gives times for thorough mixing, and the concrete is poured into individual forms in comparatively small quantities, so that each batch is inspected and puddled. When the time comes, as it soon will, according to Mr. Conzelman, when units are made in permanent factories by improved processes of manufacture, a perfectly reliable structural material will be obtained, and perhaps 50 per cent of the concrete that is now used will be saved.

The Production of Lime in the United States in 1914 was 3,380,928 short tons, according to a bulletin of the U. S. Geological Survey. Its value was $13,247,676.

Marysville, Ohio, Sewage-Treatment Plant Provides for High Degree of Purification

Screening, Two-Story Sedimentation Tanks, Crushed-Stone Contact Beds and Intermittent Sand Filters Were Found Necessary

By E. D. BARSTOW

With R. Winthrop Pratt, Consulting Engineer, Cleveland

MARYSVILLE, Ohio, a village of 4000 population, finished last year what is believed to be one of the most complete sewage-treatment plants of the smaller cities of Ohio. Local conditions, to be described later, required the installation of a plant that would give a very high degree of purification, and the plan adopted therefore included screening, sedimentation in two-story tanks, treatment in crushed-stone contact beds and finally sprinkling filters. The chief features of the plant will be here described.

Local Conditions

Marysville has a population of nearly 4000, is the county seat of Union County, and is situated about thirty miles northwest from Columbus, in the midst of rolling farm lands. Through the northern part of the town runs Mill Creek, a small stream with a flow of from 4 to 20 cu. ft. per second, into which all sewage from Marysville ultimately finds its way. About 10 miles below Marysville, Mill Creek empties into the Scioto River at a point 6 or 8 miles above the storage reservoir which impounds the water for the public water supply of Columbus. This situation gave rise to one of the chief reasons for considering the sewage purification problem at Marysville. Of little less importance was the other reason that for years Mill Creek had been rendered locally obnoxious during the summer months by sewage from the town and by milk wastes from a large milk evaporating plant located in the southwest part of the corporation. Town Run, which is nothing more than an open ditch through the middle of the town, was also badly polluted by the discharges from a number of private sewers.

On account of these conditions the State Board of Health ordered the village to construct a sewer system and sewage-treatment plant, requiring that the sewage receive a high degree of purification in view of the fact that it would ultimately contribute to the water supply of Columbus. Accordingly the village council employed R. Winthrop Pratt, consulting engineer, of Cleveland, to make the plans for and superintend the construction of the system.

Sewer System

The sewer system was designed to reach practically every portion of Marysville, the ultimate capacity being based on a population of 12,000 people, assuming a rate of 150 gal. of sewage per capita per day. About 10 miles of sewers were built, which will serve practically all of the present population of the town. Arrangements were also made to take care of the sewage from the Ohio State Reformatory for Women, which is being constructed on a site about 1 mile southwest of the village limits. This institution is planned to accommodate ultimately 1000 persons. It was possible to get a gravity flow throughout the sewer system and through the treatment plant to Mill Creek, although the sewers were laid on very low grades in some places.

The contract for the construction of the sewer system was awarded to W. M. Graham & Company, of Columbus, who finished the work early in the summer of 1914. The subsoil is generally dry clay, and little real trouble was experienced in laying the sewers.

Treatment Plant

The sewage-treatment plant was located on the site of an old gravel pit, just outside the northeast village limits, and about one-fourth of a mile from the nearest residences. The site was well above ordinary flood waters, but a dike was built entirely around the plant, the top being about 2 feet above high water of the flood of 1913, which was the worst on record in this section of the country.

The plant was designed for a capacity of 500,000 gal. of sewage per day, and can be increased in size to accommodate any probable growth Marysville will have within the next 50 years. To obtain the required degree of purification, the treatment consists of screening, sedimentation in two-story tanks, treatment in crushed-stone contact beds and filtration in intermittent sand filters, in the sequence given.

Screening and Two-Story Tank

The trunk sewer discharges into a screen chamber in which are two sets of steel-bar screens with 1-in. openings. In this chamber, also, are removable stop-planks, by means of which the sewage may be directed into either one or both of the sedimentation tanks. The two-story sedimentation tanks are each 21 x 33 ft. in inside dimensions, placed end to end, with an 8-ft. space between, in which space are placed the screen and outlet chambers. The flow channels are 9 ft. wide, with a sectional flow-area of 87 sq. ft. In passing through the 66 ft. of flow-channel length the sewage has a sedimentation period of 3 hours, based on the assumed ultimate sewage flow.

The sludge-digestion chambers have a capacity of 3500 cu. ft., intended to accommodate the storage of digested sludge for a period of 4 to 6 months. Each tank has two sludge sumps, from which lead cast-iron discharge pipes. These pipes being below the flow line of the tanks, the sludge may be drawn off at any time by opening a gate-valve in the pipe line. The sludge is discharged upon a sludge-drying bed adjacent to the sand filters.

CONTACT BEDS AND FILTERS

The sewage goes from the sedimentation tanks to the control chamber in the middle of the contact beds. In this chamber are automatic siphons, which dose the sewage out into the contact beds in rotation. There are four contact beds, each 90 ft. square, filled with crushed stone to a depth of 4 ft. They are designed on a basis of 2000 persons per acre-foot. The beds have concrete walls throughout and are drained by 5-in. split tile, laid in rows 6 ft. apart on the 4-in. concrete floor. The controlling apparatus was installed by the Pacific Flush Tank Company.

The four sand filters are each 125 x 175 ft., filled with sand to a depth of 2 ft. The sewage from the contact beds goes into a distribution chamber in the middle of the sand beds, from which it is dosed out onto the beds through hand-operated shear gates, and distributed over the beds by wooden troughs. These troughs go entirely around the concrete walls of each bed with an additional line laid lengthwise of each bed. The discharge from the troughs is regulated by means of adjustable gates.

The sludge bed, 8 x 353 ft. in size, adjoins the sand filter beds and drains into them. It has a 6-in. layer of ¾-in. stone in the bottom, with a 12-in. layer of filter sand over it. The sand filters are drained by lines of 6-in. sewer pipe, laid with open joints and covered with ¾-in. crushed stone, leading to a common outlet chamber in the middle of the beds. From here the outlet sewer leads directly to Mill Creek.

The sand for the filters is a fine lake sand, supplied by the Kelley Island Lime & Transport Company, Sandusky, Ohio, and is obtained from the bottom of Lake Erie by suction dredges. Some difficulty was experienced in getting this sand to keep its effective size constant.

HANDLING EFFLUENT

In the outlet chamber of the filter beds is a centrifugal pump, with a 6-in. discharge and 8-in. suction, direct connected to an electric motor on the floor above. The motor will be started and stopped by an automatic float switch, so arranged that the pump will operate whenever the water in the outlet chamber rises to a certain height. The discharge pipe from the pump runs across the filter beds to a manhole in the outlet sewer. In this manhole is a flap valve, so arranged with counter weight and float that it will close by the action of a backward flow from the creek in the outlet sewer. The flap valve in the outlet sewer operating in conjunction with the pump in the outlet chamber of the filters is expected to prevent any possible flooding of the beds during high water.

Messrs. Epps & Milligan, of Marysville, were the contractors for the construction of the sewage-treatment plant, which was completed and put into operation in the fall of 1914. Alvi Graham is city engineer. The writer was resident engineer on the construction of the treatment plant.

The cost of the sewer system was approximately $65,000, and that of the treatment plant about $55,000.

Port Channels of Venice Kept Clear by Tidal Movement Properly Controlled

Prof. Luigi Luiggi Describes Jetties Built to Improve Natural Channels and Insure Navigability—How to Aid the Forces of Nature

ESTUARIES are notoriously difficult to keep free from deposits of sediment which impede navigation and require expensive dredging or costly construction in navigable harbors. In notes presented before the International Engineering Congress entitled "Works for the Improvement of Navigable Estuaries" Prof. Luigi Luiggi, inspector general of engineers and professor of hydraulic construction at the Royal Polytechnic of Rome, Italy, described the successful construction of jetties in Venice, in relating Italian experience in this work. The following is an abstract of the paper relating to the work at Venice.

PORT CHANNELS OF VENICE

In order to improve the natural channels of approach from the sea to the lagoons of Venice, two jetties were built at the entrance of the port or passage of Malamocco of sufficient length to reach the contour of 26¼ ft. below depth below datum. The width between jetties was fixed at 1542 ft. in order to guide the mass of water that flows from the lagoon lying within, which has an area of 63.2 sq. miles, under the action of the tidal movement. This tidal movement varies from 1.3 ft. at neap tides to 2.4 ft. at spring tides, and exceptionally to 4.3 ft. in equinoctial tides when combined with strong winds.

With this construction, and without the need of dredging, the bar at the entrance of the channel, which was covered only to a depth of from 6½ to nearly 10 ft. at low tide, was carried away by the natural current, and the channel now maintains itself very well at a depth of about 33 ft. at low tide.

A similar construction was carried out at the Lido entrance, which gives access more directly from the sea to the commercial and military harbors of Venice. The lagoon of the Port of Lido having an area of 112.4 sq. miles and the tidal movement being similar to that at Malamocco, it was decided to carry the jetties out to the contour 26 ft. below datum. The width of the channel between the jetties was made 2950 ft. with the hope of thus realizing a tidal current with a velocity of from 2 to 3¼ ft. per second from neap to spring tides, which should be sufficiently strong to maintain the channel clear of obstruction and at the same time give conditions favorable for navigation, by reason both of the width of channel and of the moderate velocity of current.

RESULTS ARE SATISFACTORY

The results have been very satisfactory. Before the work was carried out the depth of water on the bar was 7.9 ft., while at present the depth is 28 ft. However, as a result of the accepted width given to the channel itself, its course is somewhat irregular and tortuous, and certain shoals of sand tend to re-establish themselves.

It would have been better to have given to the channel a somewhat reduced width by building a counter jetty within—as was done at the Hook of Holland in order to correct a similar condition which developed at the mouth of the New Maas—otherwise it will be necessary to dredge out the shoals. It has been decided as preferable, at least for the present, to resort to dredging as being simpler and cheaper in first cost.

CONCLUSIONS

The conclusions to which we are brought, as well by the works of Dr. Corthell as by those of Italian engineers, which are based on the results of experience so successfully executed for the improvement of the ports of Malamocco and Lido at Venice, and of Ravenna, and on which are based the proposed works at the port of Chioggia, are the following:

1. In order to improve the navigability of estuaries it is preferable, in general, to construct jetties which restrict between them and guide to the open sea and beyond the neutral zone the waters of the river or of the lagoon in their movement, especially under tidal influence. For certain special cases, where the construction of jetties may involve an excessive cost or where the bottom may be too unstable, it may be better to depend on dredging.

2. In any case it should be the aim to improve an existing channel and to aid the action of the forces of nature, making the least possible change in their present régime.

3. The jetties should be rectilinear, parallel with each other and tied carefully into the shore formation.

4. The orientation of the jetties should be adjusted with due regard for the direction of the prevailing waves and of the tidal current, in order thus to avoid obstructing, but rather to facilitate, the escape from the estuary of the water and material held in suspension or eroded from the bottom.

5. The extremities of the jetties should be carried to the depth of the contour line which corresponds to the depth which is desired to realize in the navigable channel, and in any case they should be carried at least as far as the neutral zone in accordance with the régime of the sea waves at the mouth of the estuary. It may be assumed that such zones in the upper Adriatic, where the waves may reach a height of about 13 ft., will be found between the contours for from 16 to 23 ft. below datum; in the Mediterranean, where waves are met with to a height of 23 ft., the neutral zone will be found between the contours for from 26 to 29½ ft. below datum; and in the Atlantic and in other cases with waves still higher, the neutral zone may be found at a depth even exceeding 33 ft. below datum.

6. Where aid is available from a powerful mass of water, as from a large river or from strong tidal currents, and especially from large lagoons, in which move alternately great masses of but slightly turbid water, the neutral zone is found in depths sensibly less; hence the jetties need not be carried out so far, and the problem receives a still simpler and more certain solution. It is well to recall, in this connection, the Venetian saying, "A large lagoon makes a good harbor."

7. The section of the channel between the jetties should have approximately the

same area as that found in the branches of the estuary which lend themselves most effectively to the needs of navigation, and in restricting this area it should be remembered that the bottom current must reach at least 2 ft. per second in order to be able to exercise any erosive action and to prevent filling up of the channel, while that in the main body of the channel should not sensibly exceed 3½ ft. per second, in order not to interfere with navigation. In case of doubt it is better to adopt a large width between the jetties, with the process in reserve of a further narrowing by means of an auxiliary or countermole, as experience may determine, rather than run the risk of giving to the channel too small a section, an error which can only be corrected by the removal of one of the jetties, or otherwise by the use of auxiliary dredging, as at the Lido at Venice.

8. The jetties should be constructed in such manner as not to permit penetration by sand and silt which collect on the outside—a condition which gave much trouble at the old jetties at Port Said—and they should be of sufficient height above high tide to prevent ready overtopping by the waves, with a resulting deposition in the channel of the matter which they may carry in suspension.

9. The construction of the jetties should be carried forward with the maximum speed in order to prevent the re-formation of the bar at the outer end in proportion as the jetties advance into deeper water.

10. Due account should be taken of the natural and inevitable development of the shore adjacent to the channel and of the consequent and necessary future prolongation of the jetties.

11. It is useful to aid and to accelerate by means of dredges the first work of erosion of the natural currents which run between the jetties, especially for removing possible banks of clay or conglomerate which the current by itself may not be able to erode. It is further necessary to move old skeletons of ships which have been wrecked on the bar or on the shoals of the estuary, as were met with at the port of Lido at Venice.

12. It is necessary to watch the channel carefully in the early years, and to correct, with suitable work by dredges or with the use of fascines, any possible tendency of the current to follow a tortuous path between the jetties.

The conclusions above enumerated are applicable to estuaries, in general, in order to render them navigable; but there may be very special cases where the use is so continuous and exacting that it may appear, from reasons of finance or urgency, more expedient—as at Liverpool, New York and Buenos Aires—to depend entirely upon the use of dredges rather than to face the heavy initial cost of the construction of jetties. Jetties, however, have given very satisfactory results at the south pass of the Mississippi and at the ports of Malamocco and of Lido at Venice; they demanded a heavy expense for first construction, but have required only slight expense for subsequent maintenance.

A TRANSMISSION LINE IN CALIFORNIA runs 115 miles in a perfectly straight line with the exception of a single angle of deflection. The line carries electrical energy at 110,000 volts from the Drum powerhouse to the Cordelia substation.

Literature

For the Civil Engineer and Contractor

New Publications

BOSTON TRANSIT COMMISSION, twenty-first annual report, for the year ending June 30, 1915. Paper, 6 x 9 in.; 102 pages; illustrated. Boston, Boston Transit Commission.

EQUIPMENT FOR CURRENT-METER GAGING STATIONS. By G. S. Lyon. Water Supply Paper 371, U. S. Geological Survey. Paper 6 x 9 in.; 64 pages, illustrated. Washington, Government Printing Office.

JAHRBUCH DER TECHNISCHEN ZEITSCHRIFTEN-LITERATUR. By Heinrich Rieser. Edition 1915 for the literature of the year 1914. Paper; 6 x 9 in.; 98 pages. Berlin, Germany, Verlag für Fachliteratur, Gesellschaft.

GRAPHICS AND STRUCTURAL DESIGN. By H. D. Hess, M. E., professor of machine design, Sibley College, Cornell University. Second edition, revised. Cloth, 6 x 9 in.; 444 pages; illustrated. New York, John Wiley & Sons, Inc. $3 net.

ELEMENTS OF HIGHWAY ENGINEERING. By Arthur H. Blanchard, C. E., A. M., professor in charge of the graduate course in highway engineering, Columbia University. Cloth, 6 x 9 in., 514 pages; illustrated. New York, John Wiley & Sons, Inc. $3 net.

THE ELASTICITY AND RESISTANCE OF THE MATERIALS OF ENGINEERING. Seventh edition, thoroughly revised. By William H. Burr, C. E., professor of civil engineering, Columbia University. Cloth, 6 x 9 in.; 928 pages; illustrated. New York, John Wiley & Sons, Inc. $5.50 net.

ENGINEERING GEOLOGY. By Heinrich Ries, Ph.D., professor of economic geology in Cornell University, and Thomas L. Watson, Ph.D., professor of economic geology in the University of Virginia and State geologist of Virginia. Second edition, enlarged. Cloth, 6 x 9 in.; 722 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

MECHANICAL DRAWING FOR COLLEGES AND UNIVERSITIES. By James D. Phillips, B. S., professor of drawing and assistant dean, College of Engineering, University of Wisconsin, and Herbert D. Orth, B. S., instructor in drawing, University of Wisconsin. Cloth, 6 x 9 in.; 283 pages; illustrated. New York, Scott, Forsman & Company.

INFLUENCE OF TEMPERATURE ON THE STRENGTH OF CONCRETE. By A. B. McDaniel, Bulletin 81, Engineering Experiment Station, University of Illinois. Paper, 6 x 9 in.; 24 pages; tables and diagrams. Urbana, Ill., University of Illinois.

Report of tests of forty-five 6 x 6-in. cylinders, fifty-one 6-in. cubes and sixty 8 x 16-in. cylinders under varying temperatures from 30 to 90 deg. Fahr.

COMPARATIVE RAILWAY STATISTICS—UNITED STATES AND FOREIGN COUNTRIES—1912. Compiled by the Bureau of Railway Economics. Paper, 6 x 9 in.; 78 pages. Washington, D. C., Bureau of Railway Economics.

Tabular matter divided into two parts, Part I consisting of basic statistical tables for the individual countries throughout the world, and Part II giving comparative averages and ratios derived therefrom for such items as total and unit mileages, tonnages, revenues and expenses.

GUIDE TO THE REPORTS OF THE ROYAL COMMISSION ON SEWAGE DISPOSAL. By G. Bertram Kershaw, engineer of the commission. Cloth, 5½ x 8½ in.; 178 pages, New York, D. Van Nostrand Company; London, P. S. King & Son, Ltd. $2 net.

A handy reference to the subject matter in the 30 separate volumes covering the commission's work. From each report all headings and subheadings have been extracted, thus giving in condensed form the subject matter contained in them, with page number and volume number references.

Books Reviewed

The Elements of Mechanics of Materials

Author, C. E. Houghton, A. B.; M. M. E.; associate professor of mechanical engineering, New York University. Second edition revised and enlarged. Cloth 6 x 8½ in.; 216 pages, 94 illustrations. New York, D. Van Nostrand Company. $2 net.

Reviewed by F. H. Constant

Professor of Civil Engineering, Princeton University, Princeton

This is the second edition, revised and enlarged, of a work which appeared in 1909. It is not intended as a treatise on the mechanics of materials as that field has been thoroughly covered by others. But it is an elementary text-book for a short, one-term course. The author presents the subject in a simple and clear manner, and while he may appear to develop very elementary matters in a somewhat leisurely way, the subject is one which students ordinarily find inherent difficulties in understanding. It could not be expected that so small a volume, a little over 200 pages, could touch more than the usual basic topics, and that only in a comparatively elementary manner.

The range of the book is indicated by the chapter headings, covering applied mechanics (the nature of stress, strain and elasticity), riveted joints, beams, the elastic curve, long columns, combined stresses, and compound beams and columns including the mechanics of the reinforced-concrete beam.

The second chapter contains a brief and approximate treatment of the thick pipe which might seem out of place in an elementary work. The theory of the elastic curve is brief but should convey a clear idea of the fundamental principle. In the chapter on long columns, Euler's formula is emphasized, but the other formulas in practical use, Rankine's, Ritter's, the parabolic and the straight line formulas also receive brief mention. Throughout the book an extreme mathematical treatment is avoided, but the calculus is freely used when it leads to clearness.

A valuable feature of the book is the long lists of examination questions and practical problems which follow at the close of each chapter and supplement the text in a very thorough manner. The treatment of the reinforced-concrete beam is the standard one now adopted in all text-books, and covers the simple beam (linear variation of stress), T-beam, shearing and bond stresses, diagonal tension, and a short mathematical treatment of the deflection of concrete beams. There are no accompanying diagrams to simplify the practical use of the formulas.

The book closes with a few tables, in the first three of which are collected for convenient reference the fundamental and derived formulas. The other tables give average constants of materials, properties of sections, standard beams, etc. The book should prove a serviceable little volume for an elementary course. It is intended to be supplemented by Merriman's more complete treatise.

Field Engineering

Authors, William H. Searles and Howard Chapin Ives, professor of railroad engineering, Worcester Polytechnic Institute, seventeenth edition. Leather, 4 x 7 in.; 632 pages, 148 illustrations. New York, John Wiley & Sons, Inc. Vols. I and II, text and tables, in one book, $3 net; separately, $2 for each volume.

Reviewed by A. F. Comstock

Associate in Railway Engineering, University of Illinois, Urbana

Searles' pocketbook needs no introduction to railway engineers. For more than a third of a century it has served as a companion to engineers in both field and office. The new seventeenth edition, which appears under the joint authorship of Searles and Ives, is a thorough revision, retaining the essential characteristics of the previous edition, but adding approximately 100 pages thereto, divided almost equally between text and tables. Lest the title should mislead those not familiar with the book, it should be said that "Field Engineering" as here used applies to railway engineering only, except in so far as the tables, which comprise half the book, have other application.

Prominent among additions to the text are the following chapters: "The Spiral Curve," Earthwork Tables," "Earthwork Diagrams," and "Haul and the Mass Diagram." By expanding the work previously given on "Cross-Sections" a new chapter of that title has been formed. The same is true of "Tracklaying." A complete revision of the chapter on "Turnouts and Crossings," making the treatment accord with modern practice, has been well executed. Twelve of the nineteen chapters have undergone only minor revisions.

The spiral presented in both the text and tables is the Searles, most of the material for which is taken from Searles' "Railroad Spiral," published in 1890. Why this particular spiral was selected without first discussing its advantages and disadvantages, or at least according some recognition to better known spirals, is not made apparent. There is also a lack of clearness with respect to the method of deriving the fundamental theory. The nomenclature for curves and spirals as adopted by the American Railway Engineering Association has not been followed.

Changes in the tables consist chiefly of additions, sixteen new tables having been inserted. Eight of these are on the spiral, two on turnouts, and one each on triangular prisms, prismoidal corrections and metric curves, while the others are of minor importance. Six-place logarithms have been retained in all of the logarithmic tables.

Since some engineers find need in the field for a book of tables only, either the tables or text may be obtained in a separate volume. Superior quality is plainly evident in the bookmaking.

Simplified Reinforced-Concrete Mathematics

Author, Melvin D. Casler, B. E. Cloth, 5 x 7 in.; 66 pages; illustrated. New York, D. Van Nostrand Company. $1 net.

Although the claim of the author of this little book to having developed formulas and methods which effect a large saving of time over prevalent methods of computation of reinforced-concrete members, even when aided by tables and diagrams, is not wholly justified for the simple beam-and-slab computations, he has developed an ingenious circular scale easily used to find the four variables entering into his new formulas. For computing stresses in columns eccentrically loaded or arch sections where combined bending and direct stress exist the formulas and methods given appear to be easier to handle than the standard formulas now in use.

The book is divided logically into four chapters, treating successively the derivation of formulas, labor-saving devices, illustrative examples and general notes on reinforced-concrete design.

In the first chapter the formulas to be applied are developed with satisfying clearness except in some cases where the logical steps are not stated. The statements of fundamental conditions for equilibrium called A and C are not properly worded to give an exact conception of these important principles. The distinctive basis of the formulas and new set of variables used is the value of x, the ratio of depth of steel *below* the neutral axis to the depth d. A set of ten equations is developed, in terms of four variables containing this quantity x. A table giving values of the constants used in computing bending moments in beams for various end conditions is also given in this first chapter.

The second chapter explains the devices used to save time in obtaining the four fundamental variables in terms of x, including a circular diagram, curves on rectangular co-ordinates, tabular values, and the method of constructing a slide rule. The third chapter gives the typical procedure for solving the various problems and illustrates the use of formulas by actual examples. A comparison of the time and number of distinct operations involved in the solution of the simpler problems given by the author as compared with the standard formulas and diagrams shows the latter to be more direct and shorter. In fact, there is danger that the new formulas, containing terms whose meaning is not capable of definite statement in physical terms, may lead to errors of substitution which might be serious. The problem used to illustrate the application to arches is a reinforced-concrete conduit in which the true line of pressure is assumed to be known, and in this case the author's methods may prove to be superior.

The last chapter, containing a general discussion of the practical phases of reinforced-concrete design, contains little of a new or unusually helpful character. On the whole the book is well illustrated and gives evidence of careful typographical work, especially in the numerous formulas. It should prove to be of special interest to those concrete designers who take delight in new mathematical methods and are not already wedded to any particular set of tables or diagrams.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Civil Engineers' Association Would Better Public Service Conditions

SIR: The Massachusetts Public Service Civil Engineers' Association was organized about four years ago with headquarters in Boston. Its membership numbers 300, and is composed of persons employed in the civil engineering public service of the Commonwealth and of the City of Boston. All members must be on the civil service classified list of the civil engineering service, and are under the jurisdiction of the Massachusetts Civil Service Commission. Monthly meetings are held from October to June inclusive. The chief objects of the association are to increase efficiency and further the interests of its members and the civil engineering profession in the public service.

Much has been accomplished by the association since its organization. For the most part, the attitude of heads of departments and those in charge has been admirable. Some attempts at intimidation of members have been made, but these will be dealt with in due time and in a proper but no less certain manner. In the City of Boston we have succeeded in obtaining a standardization of salaries in the civil engineering service, which, though not what it should be, and imperfect as it is, is an advance in the right direction. It is our aim to have established in the public service of Boston and the Commonwealth a system of automatic promotions in the civil engineering service, based on efficiency and the merit system.

Too elastic and inefficient civil service rules and regulations have demoralized the service. Dissatisfaction with conditions is rampant. Incompetent men are being employed in certain grades of the service without being obliged to qualify by civil service or any other kind of examination. The civil service books are full of temporary and provisional appointments due to the inefficient civil service rules relative to provisional and temporary appointments. This abuse is flagrant, and an immediate revision of civil service rules and regulations appertaining to the civil engineering service in this State seems imperative and desirable, else incompetency will soon run riot, and inefficiency and waste of public moneys be the inevitable consequence.

The Massachusetts Civil Service Commission has seemed unable to cope successfully with the situation, principally because of interference, and lack of proper co-operation of certain department heads. Imagine a situation where a chairman of a State commission, the duties of which are chiefly civil engineering, himself not a civil engineer, defiantly refuses to obey the rules established by the Civil Service Commission. Yet such has been the case. Is it any wonder demoralization exists?

Recognizing this state of affairs the association undertook the task of bringing order out of chaos by preparing a set of regulations, designed to strengthen true civil service, increase efficiency, regulate compensation of those employed in the State civil engineering service, and prevent the employment henceforth of incompetent men, in the form of a bill introduced into the Massachusetts Legislature of 1914. The bill is admittedly an admirable one and lofty of purpose, and was drawn by a committee of civil engineers after long and arduous study. There was no apparent opposition, but on the contrary it met with the approbation of the Civil Service Commission and many public-spirited citizens. Notwithstanding, after public hearings in committees where no opposition was presented, the bill failed to pass the lower House and was referred to the next General Court.

Undismayed, the association again introduced the bill in its original form into the State Legislature of 1915. The committees of the lower House to which it had been referred reported favorably. No opposition was encountered, and the lower House passed the bill by an overwhelming, practically unanimous, vote.

The bill, in regular course of procedure, next went to the State Senate, where it was referred to the Senate committee on ways and means. Here again, at the public hearing on the bill, there was no opposition whatsoever. Nevertheless this committee, after listening to a masterly presentation in favor of the bill by former State Attorney General Herbert Parker, referred the bill to the State Commission on Efficiency and Economy for a report upon it not later than Jan. 16, 1916. This uncalled for delay, while disappointing, has been accounted for and made clear by developments since come to light. The publicity of the facts would cause a sensation, and will be undertaken at the proper time. However, the association is determined to force a change for the better of conditions so detrimental to the civil engineering profession and inimical to the interests of competent and efficient public service.

We are fearless in the stand we have taken with never a doubt in our minds as to the ultimate result. It is common knowledge that those employed in the civil engineering public service in Massachusetts have long been ridiculously underpaid, and there exists as a result widespread dissatisfaction.

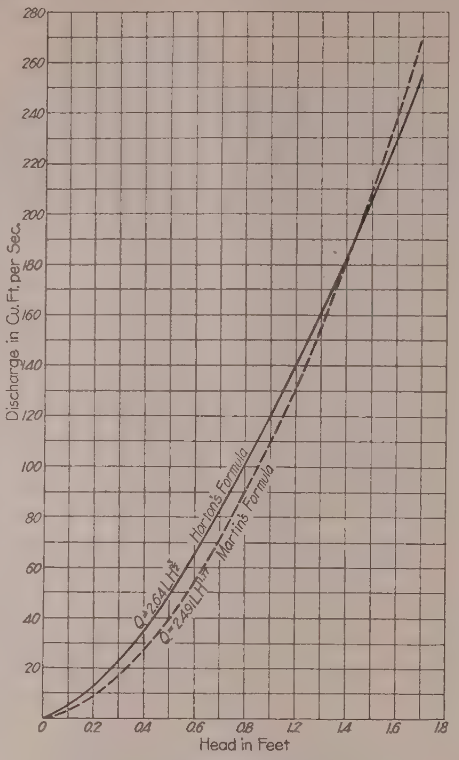
A perusal will show that nothing but justice is asked for in the bill. The salaries prescribed and promotions specified are far less than would be acceptable, or that now obtain in New York, Chicago, Philadelphia and elsewhere in the country. Yet they would be a distinct advance over existing conditions here. The civil service portions of the bill are such that the public service will become vastly more efficient immediately as they are put into effect. Then, all applicants must thereafter qualify by proper civil service examination, an absolute essential to true civil service.

Charles C. Carroll,
Secretary, Massachusetts Public Service Civil Engineers' Association.
Boston.

Run-Off Formulas for Small Spillways Compared

Sir: The spillway of the dam of the Cienfuegos water-supply system on the Hanabanilla River has a width of very nearly 5 ft. and a length of 52½ ft. Its height above stream bed is about 18 ft. Its downstream edge is curved slightly ($r = 1$ ft.). It is thus apparent that the dam and its spillway resemble very closely the Merced dam and its spillway. For the discharge of this spillway W. F. Martin found a coefficient of 2.491 and an exponent for H of 1.77 in the formula $Q = CLH^n$. R. E. Horton in Water-Supply Paper 200, U. S. Geological Survey, found for the same formula a coefficient of 2.64 and an exponent of 1.5 for H, to be used for all dams with a width greater than 2 ft. and within such limits of head that the nappe does not adhere to the downstream face for low heads and does not tend to detach itself from the crest with higher heads.

Both these formulas have been solved for use on the spillway of the dam across the Hanabanilla River, Martin's formula for heads from 0 to 18 in. by eighths and Horton's formula for heads from 0 to 1.5 ft. by hundredths of feet, and the two have been plotted for purpose of comparison. It is seen that for heads below 1.24 ft. Martin's values give more conservative results, and for heads above 1.24 ft. Horton's values give more conservative results.



HORTON'S AND MARTIN'S FORMULAS COMPARED

Recently, the height of the spillway was increased and the capacity increased by lengthening it to 75½ ft. In order to check the value of Martin's and of Horton's formulas, a weir (sharp-edged) will be built a little downstream from the dam, as soon as the dry season starts, and as long as possible gagings will be taken on the sharp-crested weir and the spillway which will serve as additional data to the work of Horton and of Martin, in at least in the way that their work applies to the Hanabanilla dam.

F. M. Aguirre,
Chief Engineer, Cienfuegos Water Supply and Sewerage Systems.
Cienfuegos, Cuba.

Activated Sludge and the Baltimore Sewage Experiments

Sir: The communication published in your issue of July 3, page 23, relative to the Baltimore sewage treatment experiments, has only just come before my notice. I should like to comment upon the suggestion contained therein, and to refer briefly to my own experience in this connection.

While engaged as consulting engineer in charge of the sewage works extension scheme for the City of Manchester, at Davyhulme, England, I had much to do with the preliminary work done there on the activated sludge process. I have since given a good deal of thought to the numerous problems arising, and have designed several plants both on the fill-and-draw and continuous-flow methods of treatment.

During July, 1914, F. Fries, chief engineering assistant to Dr. Imhoff, of Essen, was engaged temporarily in my office in the design, under my direction, of special types of tank for the "roughing" of detritus tank effluents, and on the completion of this work, he prepared several proposals for an aeration plant on the Emscher tank principle. In considering the subject we were immediately confronted with the same difficulties which form the subject of Mr. Requardt's communication, and, at the time war broke out and Mr. Fries was compelled to return to Germany, I believe we were well on the way to a solution of the difficulties.

Space prevents one from a full discussion, but I may say that the lines upon which our proposals were drawn up differ materially from those illustrated in the letter of Mr. Requardt. The method shown in the sketch would appear to me to result in the bulk of the inflowing sewage passing across the oxidizing chamber with very little and insufficient aeration, and a danger of stagnation in the lower part of the chamber. It occurs to me that the type of tank illustrated will not give the best results for the continuous flow method, and that to be effective the inlet should be much lower in the tank in a space when there is no possibility of air escaping up the inlet pipe.

This method of treating the problem, however, immediately leads us back to the consideration of the upward flow process, which seems to offer considerable advantages in the direction of bringing about the desired results. I have been brought to the conclusion, after considerable study of the subject, that where continuous flow is adopted, the secret of success may lie in the multiplication of small units so as to allow of different oxidizing periods according to the character and volume of the sewage flow. This will permit of better and more delicate control. A series of units can be so arranged as to allow of continuous flow being used, but constant observation appears to be absolutely necessary, as the process has proved so far very sensitive; but this should be outweighed by the advantages which would accrue.

I have considered numerous proposals for aeration tanks designed on the principle of horizontal flow, and have prepared many designs, but I have come to the conclusion that, to be efficient, the horizontal flow should not be in parallel stream lines, but as sinuous as possible. How this can be done is not at present quite clear. No doubt sufficient agitation can be obtained by power-driven apparatus and an arrangement of baffles. At the same time this brings about the element of complication which is, I think, sufficient in itself to rule out any such proposal.

As the difficulty appears to be in the direction of keeping the particles of activated sludge uniformly distributed, and at the same time in intimate contact with the whole of the flow, without excessive use of air, I have prepared several proposals with a view to overcoming the difficulty.

From what I have learned so far of the process, I may say that continuous horizontal flow tanks covered with aeration tiles do not appear to me to offer the true solution of the problem. Very little is yet known of this subject and much remains to be learned before any technical adviser can be so bold as to recommend the supercession of existing plants by this process.

It therefore behooves engineers to be very cautious in this matter, and prove every step of the process under working conditions. The most efficient plants are those which are, more often than not, the most simple in construction. They are generally the cheapest in the end, both from the view of capital cost and annual maintenance.

O. J. Wilkinson,
Consulting Engineer.
Manchester, England.

HINTS FOR THE CONTRACTOR

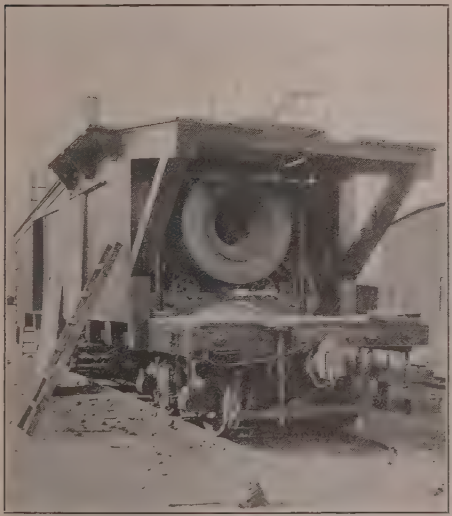
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Mixer Car Placed in Center of Train Saves Wheeling

THE MIXER train shown in the accompanying photograph is one of two complete outfits being used in track elevation work by the Chicago & Western Indiana Railroad, between Seventy-ninth and Ninetieth Streets in Chicago. As will be seen, the car carrying the mixer is placed between the cars loaded with sand and those containing the aggregate. In this way the wheelers never interfere with each other, and the distance the materials are wheeled is considerably lessened. It is said that this arrangement has greatly increased the output of the mixer. Another feature of the mixer cars is a powerful winch mounted in the center of each car. By running a line ahead from this winch, the mixer car is able to pull itself and the entire train, thus doing all its own switching and saving the expense of keeping a work train on the job, which is estimated at $25 a day. At present, the trains are being used to place concrete which is all below the level of the tracks. Later on, retaining walls are to be built for which the concrete must be hoisted. Room has been left, therefore, on each of the mixer cars for building an elevator and installing a hoisting engine.



SPACE LEFT ON CAR FOR FUTURE TOWER

MIXING PLANT

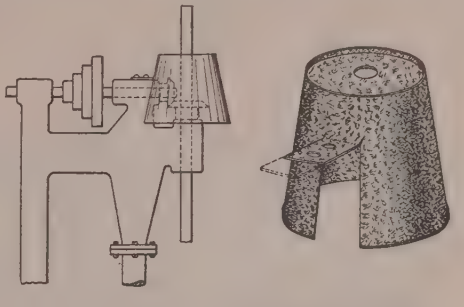
On each concrete car is mounted a No. 520 Smith-Chicago mixer, a 10-hp. engine and a 20-hp. boiler. There is also a 700-gal. water tank and a smaller 60-gal. feed tank. Each mixer is equipped with a batch hopper, and a swivel chute is mounted at the discharge end of each mixer. These chutes have intermediate openings so that concrete may be discharged at different places. The auxiliary equipment consists of seven stone cars with a capacity of 35 cu. yd. each, three sand cars with a capacity of 35 cu. yd. each and one cement car. Bulk cement is being used on all the work. The work mapped out in connection with this track elevation will take from three to four years. About 25,000 cu. yd. of concrete is to be placed this year, which requires an output of 5000 cu. yd. per month from each mixer outfit. This rate of output is being steadily maintained.

The entire work is being done by forces of the Chicago & Western Indiana Railroad, under Edward H. Lee, vice-president and chief engineer; F. E. Morrow, assistant chief engineer; V. R. Walling, first assistant engineer and C. E. Minor, assistant engineer. The job is a busy one, as the tracks on which the work is being done are used jointly by the Wabash, Chicago & Eastern Illinois, Chicago & Western Indiana, Monon and Belt Line railroads.

A WINCH MOUNTED ON THIS MIXER CAR ENABLES IT TO DO ITS OWN SWITCHING

Bucket Guard for Moving Gears

THE INEXPENSIVE, home-made guard illustrated herewith was found by a representative of the Travelers' Insurance Company in use on a drill press in a garage. The device would be equally applicable, however, to a contractor's machine shop. It consists simply of an inverted galvanized iron pail, in the bottom of which a circular hole was cut so that it might be slipped over the projecting end of the shaft. Two cuts were also made with a hacksaw on one side of the pail, as shown, and the strip of metal thus freed was bent outward and attached to the frame of the drill press by two cap-screws to hold the pail in position. Although the device is crude it guards the gears effectively. An ingenious person can often make use of homely materials near at hand in this way to fashion them into satisfactory safeguards, at least for temporary use.



BUCKET GUARDS DRILL-PRESS GEARS

Concrete Road Building in Cold Weather Requires Precautions

IF concrete roads are to be built successfully in cold weather contractors must take precautions which are unnecessary during the summer months. The following details of recommended practice are from *Concrete Roads*, published by the Universal Portland Cement Company.

When the average temperature is below 55 deg. and ranges down possibly to 35 deg., the loss of water by evaporation from the fresh concrete is low and the pavement will harden more rapidly if left uncovered so that it may derive full benefit from whatever heat the sun affords. Under these conditions it is advisable to discontinue using earth protection, because, if this be applied and wet down in the usual manner, it will become so cold that all the heat of the sun will be expended in warming the covering of moist earth and will not reach the concrete. To insure proper hardening, however, careful attention should be given to sprinkling the pavement when the temperature is at its highest during the middle of the day. By watching the color of the concrete one can tell whether it is hardening properly or drying out too rapidly, the latter being indicated by a chalky appearance.

If there is danger of frost or freezing temperatures at night, sprinkling should be omitted on work that is only a day or two old, because in comparatively cool weather, with materials at corresponding low temperature, the concrete may be damaged if the surface of the pavement is saturated with water. This is the season of year when frost or freezing temperatures may be expected almost any night, and to protect against such conditions there should be a sufficient quantity of canvas to cover one day's work at least during the night. Canvas covering is much easier to handle and place and more economical in the long run than tar or building paper, and at the same time affords better protection.

Proper heating of water and aggregates (the cement need not be heated) will result in the mixed concrete having a temperature of from 60 deg. to 70 deg. when deposited. Added warmth introduced through heated materials, combined with that which naturally develops within the concrete during the early setting period, hastens hardening and affords additional security against possible injury from low temperatures when other protection also is afforded.

LEFT—SOUTH RETAINING WALL OF RAILROAD CUT SPANS EXCAVATION FOR OUTSIDE SUBWAY TRACKS

Engineers, contractors and superintendents on the job should arrange to supply themselves with the Government weather forecasts so that a fair idea may be obtained of temperature changes that may be expected within the following 24 hr.

When the temperature falls to 35 deg. or less, concreting should be suspended. In no case should concrete be deposited upon a frozen subgrade. It is necessary to protect the last concrete laid for at least 48 hr. If straw can be obtained, the day's work may be covered with from 3 to 6 in. of this material as soon as this can be done without marring the surface; the canvas covering then is placed over all. The next day the canvas can be removed and an earth covering placed on the straw. In doing this, make certain that there are no spots only partly covered. After ten days, if the weather is favorable, the covering may be removed and the pavement allowed to harden in the open.

If steam can be obtained, it is practical to use canvas alone. This may be supported on a light framework extending from 18 to 24 in. above the concrete. The steam should be passed under the canvas, thus hastening early hardening. A night watchman can attend to this work by keeping up steam in the mixer boiler. The following day, if weather permits, the canvas may be removed and a straw or earth covering applied, thus making the canvas available for this day's work.

Concrete roads have been utterly ruined by being thrown open to traffic too soon, and every precaution on the side of safety should be scrupulously observed.

Concrete Retaining Wall Spans Cut for Subway Undercrossing

THE NEW three-track Bronx subway at Southern Boulevard and 147th Street, New York City, is being driven directly under a double-track branch of the New York Central Railroad without the use of needling or timbering. The railroad branch is in rock cut, flanked by retaining walls of mass concrete. The rock floor of this cut has to be replaced with the roof of the subway structure. This required cutting out of service one track at a time.

The south track was first taken out and the excavation for the center subway track driven under the retaining wall to the center of the railroad tunnel. The method of blasting under the retaining wall is to shoot cuts, and to drill from the sides of these fan-holes to remove the rest of the rock. These shots did not disturb the wall, although the rock was pulled out practically to the bottom of the wall, giving about a foot clearance in which to set the steel.

GROUTING WITH A WIRE

The center-track steel was then set and the roof concreted. The water-proofing and the 4-in. backing of concrete were then placed, using form boards across the roof on each side of the wall. These boards came up higher than the top of the wall. This left a slightly dished surface, lacking a few inches of being in contact with the bottom of the wall. A piece of heavy wire was run through this space from side to side of the wall and sawed back and forth across the roof by a man on each end, while the space under the 8½-ft. wall and inside the form boards was poured full of grout from both sides of the wall. The sawing was relied on to work the grout to the center and fill up all voids. That this was accomplished is indicated by failure to detect any settlement of the wall after its weight was transferred to the center track steel and cuts excavated for the two outside tracks. No wedges of any sort were used.

BOTH CUTS FOR OUTSIDE TRACKS MADE AT SAME TIME

The cuts for the two outside tracks were next driven simultaneously in the same way. When the roof over these sections is in place the south railroad track will be restored and put in service while the other track is taken out and the north half of the undercrossing constructed in the same way as the south half. The concrete retaining walls are 18 ft. 9 in. high, 8 ft. 6 in. thick in the base and 3 ft. thick at the top. They have ample strength to span the cut for one subway track as a beam, the maximum unsupported length being not over 25 ft.

In making the first cut for the center track it was thought advisable to take out a small section of rotten rock encountered under the wall on one side, and replace it with a concrete pier. This pier was removed later in taking out the flanking cut on that side. This work was the only temporary construction of any sort required to support the south wall while the subway was being built beneath it.

RIGHT—WEIGHT OF RETAINING WALL WAS TRANSFERRED TO ROOF OVER CENTER SUBWAY TRACK WITHOUT SETTLEMENT

The work is being done under the direction of the New York State Public Service Commission for the first district, Robert Ridgway, engineer of subway construction. R. S. S. Guerber is section engineer for the commission. H. R. Shailer is general superintendent for the contractors, the Richard Carvel Company, Inc.

CANADA'S SUPPLY OF COMMERCIAL TIMBER at the present time has been variously estimated at from 500,000,000,000 to 700,000,000,000 ft. b.m., and as covering an area of approximately 170,000,000 acres, stated R. H. Campbell of the Dominion Forestry Department, Ottawa, in a paper presented at the recent International Engineering Congress. This estimate of quantity and area refers only to timber of commercial value as saw timber. It does not include pulpwood, firewood, tie and pole material or small timber of any description.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Adds 1600 New Members in Four and a Half Days

Engineers' Club of Philadelphia Makes Remarkable Record in Membership Campaign

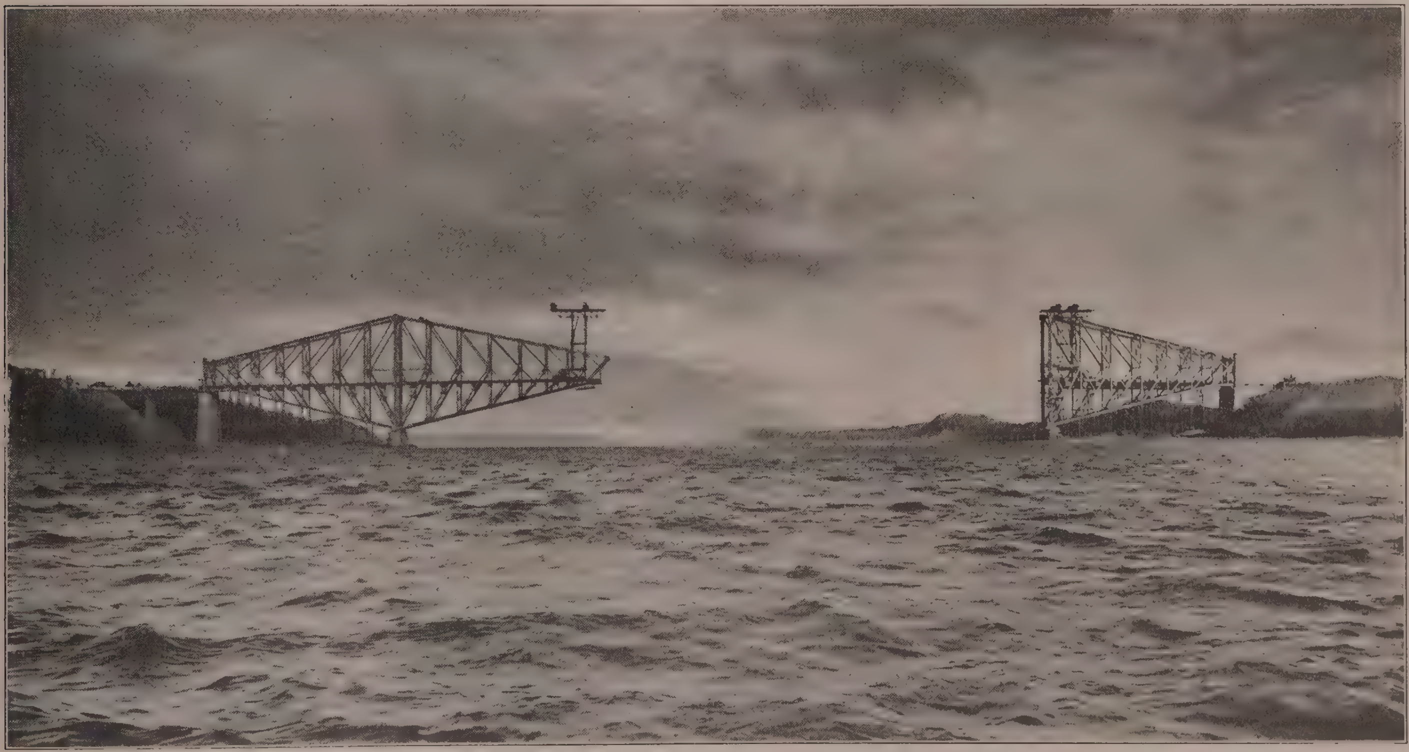
On Friday Nov. 12, the Engineers' Club of Philadelphia brought to a close a membership campaign which added 1576 new names to the roster, bringing the total membership of the club to 2127 and making it the largest local engineering club or society in the country. Since the close of the campaign 236 additional applications have been received, bringing the total membership of the club to 2363. The roster of the club at the beginning of the campaign showed a total membership of 551, while accessions for the last fiscal year were only 36.

The campaign may be considered the climax of a movement which started in the club in the autumn of 1913. It was then proposed that all the local branches of national engineering societies be affiliated with the club and make use of the club's facilities for their meetings. This plan was consummated early this year. Under it the Philadelphia sections of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Illuminating Engineering Society and the Alumni Association of the Massachusetts Institute of Technology have become affiliated organizations. Their members are entitled to attend the meetings of their organizations in the clubhouse and to enjoy the privileges of the club on the afternoons and evenings of the meetings. For these privileges the local branches pay annually $1.50 for each of their members.

The suggestion of a great membership campaign was made about a month ago and found ready support with the officers and membership

(*Continued to page 646, first column*)

Progress up to Schedule on Quebec Bridge Erection at Close of 1915 Season



SOUTH ANCHOR ARM, INCLUDING MAIN POSTS, NORTH ANCHOR AND NORTH CANTILEVER ARMS COMPLETED, AS THEY APPEARED ON NOV. 9

Valuation Discussed from Consumers' and Regulators' Point of View

Commissioners, Lawyers, Economists and Engineers Develop Theories of So-Called Public Side of Problem—Minority Champions Contentions of Utilities

A wide range of theories on the moot questions of the valuation of public utilities, and even on the status of such utilities, was set forth in the conference held in Philadelphia, Wednesday, Thursday and Friday of last week, under the auspices of the Utilities Bureau, as announced in this journal in the issue of Nov. 6, page 583. Commissioners, lawyers, economists, accountants and engineers assembled from all parts of the country; 190 registered, although there were probably 250 present. In the seven sessions, the last being a dinner, seven phases of the great problem were discussed. In general the doctrines presented were those of the so-called public interests, but a sprinkling of champions of the utility point of view voiced their protests and added zest to the meeting. Limited space prevents more than an outline of what seem the principal addresses and comments.

The first session, Wednesday evening, was devoted to the reproduction theory. Morris L. Cooke, director of public works of Philadelphia, and acting director of the Utilities Bureau, explained the purposes of the bureau, and of the conference. He stated that as the utilities were well equipped to present their side of valuation questions, it was thought well for the consumers and regulators to assemble to develop their side.

Reproduction Cost

John M. Eshleman, lieutenant governor of California and former president of the California Railroad Commission, criticised emphatically the reproduction theory of valuation. An abstract of his paper is printed on page 625.

H. F. French, attorney, Baltimore, also decried "reproduction value." He contended

Sale of $2,000,000 in Hetch Hetchy Bonds Approved

The entire $43,500,000 Hetch Hetchy bond issue, which provides for the construction of the new water supply system for San Francisco, would be sold within the next five years if the Mayor had approved the measure passed by the Board of Supervisors of San Francisco on Oct. 25. The Mayor vetoed the measure, however, on the ground that only $15,000,000 of the Hetch Hetchy bonds could be used during the next five years, the sale of the entire $43,500,000 being a poor business policy.

In his message to the Board of Supervisors, the Mayor recommended the immediate sale of $2,000,000 worth of bonds to obtain funds for the construction of a railroad into Hetch Hetchy Valley. He advocated that further sales be made as the money is needed. It was also recommended that immediate action be taken to have the State Railroad Commission place a valuation upon the property of the Spring Valley Water Company in order that the question of purchase may again be submitted to the voters of San Francisco.

that if it were used it must logically be applied to the best substitute plant. He thought, however, that utilities would not advocate the reproduction theory if prices of land, labor and material had steadily fallen.

Morris Knowles, consulting engineer, Pittsburgh, took a different view on several ideas that had been expressed. He deplored the confusion of the terms "cost" and "value," and thought if cost figures were treated strictly as such, numerous disturbing factors would disappear. He said reproducing a substitutional plant would be grossly unfair, as substituting hindsight for foresight. He asserted that all elements of cost must be included, even if not shown on the books. He denied that proper estimates were mere guesses. He also denied that "reproduction cost" was an engineers' invention, and averred that legal authority in its support was not lacking. He contended that engineers had a right, as had been previously denied, to express opinions as to value.

Another point made by him was that court decisions do change with the times.

Original vs. Reproduction Cost

Original cost was the assigned subject for the first Thursday session. The first paper, however, by George W. Anderson, attorney, Boston, was on "How to Get Rid of the Reproduction-Cost Theory." He held that the absurdity and injustice of the theory had been fully demonstrated. Its existence he accounted for by the necessity of the courts to establish a basis of value to prevent confiscation, the rate-making legislative bodies having failed to establish any basis. He declared the agency theory of utilities to be the only sound one. He held that utilities were entitled only to fair return on actual investment, and that a code to that effect, like the Massachusetts code, would get rid of the reproduction theory.

Prof. Edward W. Bemis of the advisory board of the Division of Valuation, Interstate Commerce Commission, speaking on "Original Cost as the Chief Basis for Fair Value," also advocated the agency theory, and the disallowing of unearned increment. He voiced a warning that if the increment on land is allowed in the Federal valuation of the carriers the figures will be astounding and will justify startling increases of rates.

Dr. Robert H. Whitten, author of two extensive volumes on the "Valuation of Public Service Corporations," advocated normal actual cost, one reason being its greater stability. He held that rate schedules should not fluctuate with the price of copper wire or iron pipe, and a reproduction cost constantly varying in consequence of such fluctuation.

Edward P. Burch, consulting engineer, Detroit, directed his attention to the engineer's part in valuation. He pointed out that while the engineer should follow the economist and attorney, they furnishing the basis on which he is to get facts, he has had to do his part first. Mr. Burch deplored the fact that engineers could not deal direct with the courts, instead of through lawyers; thought that more attention should be given to the opinion of the engineer, who had spent hours on the subject to the attorney's minutes or seconds; held that the engineer took the ethical view of things, contrasting with the attorney, armed with "twenty decisions for and nineteen or twenty-one against."

In the open discussion F. W. Stevens, general valuation counsel, New York Central lines, and formerly member of the New York Public Service Commission, Second District, averred that reproduction cost was begot not by utilities who thought it would give a higher figure than original cost, but by a noted Nebraskan, representing the public side, who thought it would give a lower. Mr. Stevens thought there was no reason to worry about exorbitant rates if appreciation were allowed; he pointed out that although land values have been going up rates have been going down.

Frederic P. Stearns, consulting engineer, Boston, thought that while actual cost should be the basis for the future, it might be neither possible nor just for the past. He also thought it unfair to exclude expenses of construction that would now be avoided.

Maintaining Inventories

Charles L. Pillsbury, chief engineer, Valuation Bureau, Public Utilities Commission, District of Columbia, read a paper on "The Making and Maintenance of Priced Inventories," laying special stress on the classification of the inventory so that it could be put to any use desired, and on its careful maintenance so that the work would not have to be done again when another valuation was wanted.

Among those who discussed inventorying R. J. Meigs, valuation engineer, Western Union Telegraph Company, urged co-operation on the part of public and utility subordinates as the best preventive of controversies. He also urged the need of uniform instructions and methods.

Valuation by Approximation

Contrasting with Mr. Pillsbury's paper, the first paper of the afternoon session was on "Valuation by Approximation," by John G. Morse, appraiser, Associated Factory Mutual Fire Insurance Companies, Boston. Mr. Morse described short-cut methods used in appraising industrial plants in his work, especially in grouping or lumping small items of little comparative value. He thought much detail useless where so much estimating had to be done. Mr. Cooke, in discussion, expressed similar views. Mr. Stevens deplored haggling over one cent, but said that one cent per crosstie on the New York Central system meant a total of $500,000.

Mr. Stevens also mentioned that he was not worrying, in connection with valuation matters, over the question of rates, but was concerned in the credit of the railroads and their ability to get the money that would be needed for the tremendous expenditures the next ten years would demand.

Franchise Values

Dr. Delos F. Wilcox, deputy commissioner, Department of Water Supply, Gas and Electricity, New York City, read a paper on "Franchise Values." He said it was established as admissible to tax franchises according to present earning power, but that for rate-making purposes franchises need be assigned no separate value except in special cases, and that in some cases they might be liabilities.

Henry DeF. Baldwin, president and counsel of the Queens County Water Company, New York City, did not see the fairness of the diversity of valuations of franchises according to the purpose. He thought more stress should be laid on going value, which he interpreted as covering development cost, including the price paid for the original money, the skill put into the enterprise, and the risk. With suitable recognition of this going value he thought less attention could be given to franchises.

Land matters incited considerable debate in the Thursday evening session. The only formal paper was by Hammond V. Hayes, consulting engineer, Boston. The method by which Mr. Hayes arrives at what the utility would have to pay to reproduce its land, in a manner that he holds will satisfy the courts, is presented in abstract on page 626.

Agency Theory

A. E. Helm, counsel for the Kansas Public Utilities Commission, took an emphatic stand for the agency theory. He declared the railroads to be public highways, and said it was a great fallacy to suppose the companies owned them; the managers were the public agents, and the proprietary rights remained in the State. Hence, as the public owned the lands, the railroads obviously were not entitled to any unearned increment.

Mr. Eshleman said there was grave danger in the agency theory. In California there was a time when the gas company, electric company, irrigation company, was not a utility. The owners of such a company must voluntarily dedicate it to the public use, and companies might not do so for fear of the agency theory. There was, however, a servitude of railroad property independent of the agency theory. The railroad had the right to condemn property, conditional on its use for railroad purposes only. This restriction in use, then, made it less valuable than property unrestricted.

The Railroad Viewpoint

Mr. Stevens took the floor in behalf of the utilities. He said there was no mention of the agency idea in original cases. Then questions of confiscation arose, and the courts said their only function was to prevent confiscation. This gave rise to the use of the term value, which up to then had had but one definition—the power to command other commodities. And the courts have never changed the definition, he said. Various decisions were cited by Mr. Stevens in support of his contention.

Mr. Stevens stated that by the agency theory the public appropriates all of the good things and bears none of the burden of the bad things. He cited the case of the Buffalo & Susquehanna Railroad, built honestly and in good faith for $4,000,000 or $5,000,000, and sold recently for $300,000. He asked why the public had not come to the rescue.

He thought that the laying of great stress on what was actually paid for right-of-way did not make for substantial justice. In a picture which he drew a new railroad by questionable means secured land from A, B, C and D, in 1850, at a low cost. Now, in 1915, X, Y and Z have discovered this and are shocked. They do not, however, try to restore the stolen property to A, B, C and D; they appropriate it themselves.

Milo R. Maltbie, member of the advisory board, Division of Valuation, made an argument for the inclusion of unearned increment as a part of income—this being the same theory unsuccessfully advanced in the decision he wrote, as a member of the New York Public Service Commission, First District, in the Kings County Lighting Case.

Depreciation

Depreciation was the topic for the morning session, Friday, presided over by Mr. Stearns. J. H. Goetz, of counsel, Public Service Commission, First District, New York, discussed the purport of various court decisions on the subject.

Halford Erickson, member of the Wisconsin Railroad Commission, discussed the "Relation of Depreciation to the Fair Value." He developed the idea, presented by John W. Alvord and others before the American Society of Civil Engineers, of the depreciation fund as a trust fund; holding that renewals must be made out of earnings, that the unfairness of making the consumers of one year pay the entire cost of renewing a long-lived part replaced that year made necessary the setting aside of substantially equal annual installments, and that these installments must be wisely invested to produce the proper amounts at the required time. His formula for the basis of fair value was cost new minus depreciation (including accrued as well as actual) plus depreciation reserve. If the latter had been dissipated in dividends it was not entitled to earnings. He thought, however, that no deduction should be made from utilities that had not in the past collected accrued depreciation, as the stockholders had certainly withdrawn nothing from the business.

James E. Allison, consulting engineer, St. Louis, made an energetic argument for the railroad point of view, that there is no depreciation in a composite plant of perpetual life, if properly maintained. What he emphasized especially was the utter unreliability of estimates of expected life, and the failure of engineers to bring out this point forcibly.

Drawing the Curtain on the Past

Prof. John Bauer, Cornell University, argued from the agency theory. He held that in some cases capitalization of earnings that should have been made and were not would produce a total fair value on which the utility simply could not make a fair return, while in others the deduction from value of exorbitant past earnings would reduce fair value to nothing or an actual liability; that ever since the case of Munn vs. Illinois was decided the public had had the right to hold the utility to reasonable returns only, and that the investor since then had always assumed the risk that the public would exercise its right—in other words, that he had had his day. Professor Bauer would therefore draw the curtain on the past, forego, in the interests of broad justice, futile attempts at individual justice, and adopt a policy for the future that would be as near automatic as possible, holding the utility strictly to a reasonable return.

In the open discussion that followed A. M. Sakolski of the Delaware & Hudson Company valuation committee asked Professor Bauer how he would insure the utility against less than a reasonable return. Professor Bauer asserted that the return could be earned if the existence of the utility were justified and the property were properly managed. Another agency enthusiast proposed that if between rate revisions, even after the desired regulatory system was in full effect, a utility were found to have made too much, it be compelled to repay this by a corresponding reduction in return at the next revision. It was pointed out, however, that such a scheme would hardly encourage good management.

Mr. Eshleman reminded the conference that inducements must be held out for future capital, with greater compensation for greater risks. Having this in mind, he would not attempt to apply future rules rigidly to the past, but would apply them as far as possible within reason. The investor, he said, was entitled to get his capital back and a fair return, but could only have such return as the public could supply the service for, otherwise public ownership was inevitable.

Going Value

Gen. Morris Schaff, of the Massachusetts Board of Gas and Electric Light Commissioners, who presided over the Friday afternoon session on "going value," stated in a brief address that the policy of his commission to allow operating costs, full depreciation, ample and generous profits to good management, and ample allowance for contingencies (this was perhaps the only mention of contingencies in the convention), resulted in few disputes. He made two suggestions, that the financial history of the utility be carefully studied, and that distinction be made between competitive and monopolistic properties.

Clifford Thorne, chairman of the Iowa Board of Railroad Commissioners, read the main paper on "going value." He held that going value consisted of actual development costs and enhancement of value of plant from use since development. He would not allow return on the latter, and to recognize the former he would require proof of early losses not compensated since by excessive returns. In any event, he would recognize the deficits of only the first few years.

Mr. Thorne thinks neither reproduction cost nor original cost should be the sole basis for "fair value," which he concedes is only in the process of being defined. He thinks that original cost is the most effective guide, but that reproduction cost may be important.

William J. Hagenah, public utility statistician, Chicago, disagreed with Mr. Thorne that only the early experimental stages should figure in going value. He held that with the increasing operating costs of utilities, the declining purchasing power of money and the general extravagance of the last generation going value was constantly increasing. He cited the municipal utility in the fast-growing Western city, constantly compelled to extend its facilities into undeveloped sections, and never catching up so as to be in a position to prosper with the community.

Constitutional Protection in Valuation

Friday evening, at the dinner which terminated the conference, Charles A. Prouty, director of valuation, Interstate Commerce Commission, spoke on "The Meaning of the Constitutional Protection in Valuation." There is a twilight zone, he said, between the maximum rate, which the legislative body must fix, and the minimum rate, which the courts decide is confiscatory, and in this zone the rate-making power of the commission, the courts have at last conceded, is supreme. Before the commission, then, can fulfill its duty here it must know the value of the property of which it would fix the rate. The courts will presumably interfere in valuations only in questions of law, or to prevent confiscation, where a valuation has been placed in evidence in some suit involving a rate. The court, it is believed, will not set aside valuations simply because the judge is of the opinion that the amount is too small, unless there be palpable or gross errors. Hence the welfare of the public utilities is largely under the control of the public-service commissioners, and it is of first importance that the utilities and the general public should unite in securing men of the highest grade for the positions.

Opinion Testimony

Prof. John H. Gray, University of Minnesota, spoke on "Opinion Testimony." He first reviewed the evolution of the rules of evidence which resulted in the admission, about 1800, of the opinions of scientists if based on facts testified to by others. As applied to valuation he said the so-called expert testimony of engineers was incompetent; that if value was related to any science it was the science of accounting or economics, but not engineering; that engineers were not trained to a knowledge of wealth or value, and that their expert testimony along these lines was universally regarded by economists as unscientific.

He held that they were not disinterested witnesses, being well paid for their opinions, and hence being in effect assistant counsel testifying. While the main objection to opinion testimony prior to its acceptance in 1800 was held to be the danger of the emotions of man affecting his opinions, Professor Gray thought the present effects of cold calculation more dangerous.

Professor Gray also felt that the public was always at a disadvantage in securing opinion testimony in railroad rate cases, because the railroads could combine and pay more for the testimony, and because eminent engineers feared to testify for the public because of its effect on their futures. Thus courts and juries were likely to be bowled over by the sheer mass of testimony.

The last speaker of the conference was Milo R. Maltbie, who spoke extemporaneously of the shortsightedness of the railroads in making demands which, if granted, would materially alter the public attitude in the future, which attitude, he said, was one of the utility's greatest assets. If, for instance, the roads were to be allowed returns on donated property, there would henceforth be less donated property; and if, as the railroads contend, there is no real depreciation, the public will deny them depreciation reserves.

American Road Builders' Association to Hold Convention in Pittsburgh.

The executive committee of the American Road Builders' Association, acting under authority granted it by the board of directors has decided to accept the invitation of the city of Pittsburgh to hold its annual convention there. The dates set are Feb. 22-25, 1916.

In order to supply the necessary facilities, the Pittsburgh City Council recently appropriated funds to put Mechanical Hall of the Exposition Building in shape for the convention. The building is located in the downtown district, on Duquesne Way, and is easily accessible to the leading hotels.

Bridge Patents Hearings Postponed

At the last session of Congress the United States Senate passed a resolution directing an investigation by a senatorial committee into the granting of patents to Daniel B. Luten of Indianapolis. The committee was duly designated and the first of the hearings set for Nov. 8. Notices of the hearings were sent to the interested parties, but despite the fact that interests in Iowa and Kansas were active in securing the passage of the resolution none of their representatives were present to proceed with the hearing. Moreover, only one of the members of the committee itself, Senator James of Kentucky, was present. Of the interested parties, only Daniel B. Luten and his representatives were on hand to proceed with the hearing.

The committee cannot meet until there is a quorum, which consists of four members, and it is likely that no further effort will be made to proceed with the investigation until after Congress convenes.

California Needs $15,000,000 More for Highway Construction

The systematic completion of the highway system in California depends on the outcome of the new $15,000,000 bond issue proposed by the Legislature at the session early this year, and which is to be voted on in November, 1916, according to a recent statement by Charles D. Blaney, chairman of the California Highway Commission. The $18,000,000 bond issue of 1910 will be insufficient to finish the work, as $9,000,000 of this sum has already been expended, $7,500,000 will be taken up either by contracts already let or for road construction in counties which have bought bonds, and the remainder will be required to cover other contracted work and the running expenses on the work now in hand. Trunk lines are being constructed in Siskiyou and Shasta Counties, and these counties, as well as Modoc, Lassen and Trinity, are in need of State lateral roads connecting the trunk highways, but more funds must be available, Mr. Blaney said, to carry on this work as well as necessary construction in other parts of the State.

Tornado Does Heavy Damage in Middle West

A wind and rain storm that swept over Central Kansas, South Dakota and Nebraska, Nov. 10, caused the death of several persons, the injury of many others and a property loss amounting to several hundred thousands of dollars. Great Bend, Kan., was the greatest sufferer. The storm came up with scarcely any warning, damaging the waterworks and electric light plants and doing considerable damage to buildings. The excessive rainfall prevented a heavy loss from fires.

Technology Group to be Dedicated June 14, 1916

Wednesday, June 14, 1916, has been set as the date for the dedication of the new group of buildings for the Massachusetts Institute of Technology on the Charles River Basin, Boston, according to the announcement of President Richard C. Maclaurin. The time selected assures a large gathering of graduates as class day, with its student festivities, falls on the preceding Monday, followed by the graduation exercises on Tuesday. It also coincides with the annual meeting of the federation of Technology Clubs, which will convene in Boston and that of the Alumni association.

Practically all of the stone work and carving in the group have already been completed. In the interior, the floors are being finished and the rough plumbing is practically all in place. In ten of the buildings the steam heating system is ready and three-quarters of the ventilating systems are in place.

Adds 1600 New Members in Four and a Half Days

(*Continued from page* 643, *first column*)

committee of the club. Realizing that a campaign of the proportions considered would fail unless skillfully managed, the club decided to call in G. S. Whitslar, who has had special experience in compaigns for increasing society memberships and for raising funds.

It was the judgment of the officers of the club and the membership committee that the addition of 1000 new members, considering the large engineering interests centering around Philadelphia, was not impossible, and that figure was set at the goal to be attained. It was decided further to make the campaign short—from the morning of Monday, Nov. 8 to 12.30 noon of Friday, Nov. 12. The initiation fee was waived for the occasion, while it was pointed out that the annual dues, now $35 per annum, would drop to $15 if 1000 new members were secured.

Organization

The campaign organization consisted of twenty-eight teams of five men each, the captains being selected for their acquaintanceship and energy. These twenty-eight teams were than divided into two divisions, the main contest being between these larger groups. Richard L. Humphrey, consulting engineer, was placed in charge of Division A, and S. M. Swaab, chief engineer of the Keystone State Construction Company, in charge of Division B. D. Robert Yarnall was in general charge of the details of the campaign, while Dr. Edgar Marburg, professor of civil engineering, University of Pennsylvania, acted as general chairman of the campaign membership committee.

As an incentive it was decided that the names of the men of the winning division should be inscribed on a large silver loving cup to be placed in the club house, while individual prizes in the shape of trophy flags and watch fobs were to be awarded to the captain of the team bringing in the largest number of members and to his team-mates.

In order to place in the hands of prospective members data as to the objects of the club and its advantages, a 12-page pamphlet was printed. Individual methods of campaigning varied greatly with the ingenuity of the members. Personal calls, letters, telephone and telegraph messages were resorted to at the judgment of the hustlers. On each of the five campaign days a luncheon was held at the club, and short addresses were made by those with faith in the movement, who might convey a message of hope and enthusiasm to the assembled workers. At these luncheons reports were made by the team captains. At the Monday luncheon 209 applications were reported, this figure probably representing some work done before the campaign was initially under way, for application blanks and publicity pamphlets were handed to members on the preceding Friday. At the final luncheon on Friday, Nov. 12, 651 new applications were recorded, more than three times the number reported on the first day of the campaign. When the captains reported it was customary for them to read off the names of especially prominent applicants, and the daily reports proved that one of the points determined upon in the campaign—to secure the membership of prominent engineers and those of engineering training who had graduated into executive work—was well achieved. On the last day of the campaign the applications of the general manager of the Pennsylvania Railroad and of the Philadelphia & Reading Railway were read. Moreover it was announced on the final day that every engineer in the employ of the Philadelphia Rapid Transit Company had been secured as a member of the club.

The Results

At the close of the campaign on Friday the returns indicated a total of 1672 applications, 831 turned in by Mr. Humphrey's division and 841 by Mr. Swaab's, making the latter group the victor. Later revision of the applications indicated a number of duplications, so that the official count was 1576. However, immediately after the close of the campaign, on Friday afternoon, a flood of holdover applications came in, and the committee in charge of the campaign decided that the duplications in the originally reported list would be filled out from the later applications, so that the team positions remain unchanged. Applications since the close of the campaign bring the total of new members to 1812. The team trophy for the largest number of members secured by a five-man group was awarded to team 7, captained by Richard L. Humphrey.

When at the closing luncheon it was announced that the names of all of the members of Mr. Swaab's division would be inscribed on the cup, Mr. Swaab most generously insisted that, since the results were so close and the members of Division A had done such valiant work, the names of all the workers of both divisions should be inscribed. Upon this being put to the vote, the members of Division B unanimously supported their chairman and by resolution the club endorsed the suggestion.

The closing luncheon was a most inspiring function, the most striking note being the tributes paid by representative speakers to the high purpose and self-sacrificing spirit of those who shouldered the burden of the campaign. The view was expressed, too, that the larger membership involved greater responsibility to the individual members, to the profession and to the community. Tribute was paid to the value of the publicity given the campaign in the press both of Philadelphia and of Eastern Pennsylvania. It appears that some seventy papers printed the publicity matter sent out under the direction of the campaign committee.

COMMITTEE OF ENGINEERS' CLUB OF PHILADELPHIA WHICH MANAGED CAMPAIGN RESULTING IN 1600 NEW MEMBERS IN FOUR AND A HALF DAYS

1, M. Bernstein, team captain; 2, H. A. Moore; 3, M. E. Hibbs, team captain; 4, E. W. Collins, of the Philadelphia Ledger; 5, S. M. Swaab, chairman of Division B, the winning side; 6, Richard L. Humphrey, chairman of Division A and captain of five-man team bringing in largest number of members; 7, Dr. Edgar Marburg, general chairman of campaign membership committee; 8, J. W. Ledoux (president of the club) team captain;; 9, D. Robert Yarnall, chairman in charge of details of campaign, team captain; 10, Dr. Carl Hering; 11, W. R. McLain; 12, F. X. Kern, Jr.; 13, Richard G. Develin.

Corpus Christi's 15-Mile Pipe Line Practically Completed

The new 20-in. supply main of the city of Corpus Christi, Tex., built at a cost of $300,000, which will bring water from the Neuces River, about 15 miles from the city, and increase the daily supply from 600,000 gal. to 4,000,000 gal., is practically completed. The new supply is in addition to that furnished by the old 6-in. and 8-in. mains that have brought water to the city from the same source for the past 22 years. In addition, a new pumping and filtration plant has been built at the Neuces River Station, so that all of the new supply will be filtered. The plans for the consulting engineer of New York City, and plant were prepared by Alexander Potter, it was built under the direction of H. A. Stevens, city engineer of Corpus Christi. Louis Lock of Monroe, La., was the contractor.

Membership of Testing Materials Society Showing Good Growth

An effort has been made recently to increase the membership of the American Society for Testing Materials at a more rapid rate than in the past. As a result of the efforts, since Jan. 1 of this year, 331 new applications for membership have been received, as against a maximum of 277 (in 1912) for any previous calendar year. The membership of the society is now 1962 and the committee feels that an increase to 2500 by the next annual meeting can be hoped for if the membership respond to the appeal for greater activity in this respect.

Application blanks and information regarding membership in the society can be secured from any member or from the secretary-treasurer, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia.

News of Engineering Societies

The Brooklyn Engineers' Club will hold its annual dinner Dec. 2.

The Engineers' Club of Philadelphia heard Morris Llewellyn Cooke, director of the Department of Public Works of the City of Philadelphia, speak on "Impressions of an Engineer in Public Office" at a meeting held in that city, Nov. 16.

The National Civic Federation will hold its annual meeting in Washington, D. C., Jan. 17-19, 1916. The annual dinner will be at the Hotel New Willard. Among the questions which will be discussed are labor conditions, employers' welfare work, educational opportunities, business ethics and political ethics.

The Illinois Society of Engineers and Surveyors will hold its annual meeting at the University of Illinois, Champaign-Urbana, Jan. 26-28, 1916. Papers will be presented on municipal work, drainage, pumping, rivers and waterways, office records and methods, surveying, concrete work, road construction and levees and bridges. E. E. R. Tratman of Wheaton, Ill., is secretary of the society.

The Municipal Engineers of the City of New York will hold a meeting in the Engineering Societies Building Nov. 24, at which John T. Fetherston, commissioner of street cleaning, will speak on "Snow Removal in New York City."

The Associated Technical Men, an association formed in 1914 for the purpose of furthering the interests of technical men, has commenced the publication of a monthly bulletin to keep all members of the society informed as to its progress and to acquaint non-members with the work it is doing. A. M. Wolf, 180 North Dearborn Street, Chicago, is editor of the publication.

The Cornell Society of Civil Engineers elected the following officers at its annual meeting, held recently in New York City: President, John C. Wait, attorney-at-law, engineering jurisprudence, New York City; vice-president, Joseph C. Hilton of Mason, Hilton & Company, engineers and contractors, New York City; second vice-president, Charles E. Curtis of Ithaca, N. Y.; recording secretary, William M. Aitchison; corresponding secretary and treasurer, Ernest A. Truran of Yonkers, N. Y. At the meeting it was announced that the society had 815 members enrolled.

The Engineers' Club of St. Louis discussed the design and construction of the Mill Creek sewer in that city at a meeting held Nov. 17. Clinton H. Fisk, chief engineer of construction, sewers and paving of St. Louis described the arrangement for carrying the alignment on top and under the ground, the types of construction plants used, the use of the pneumatic concrete mixer and conveyor and details of reinforced-concrete sewer work in wet sand. W. W. Horner, engineer in charge of design, sewers and paving, gave a brief history of the sewer system of the city, and particularly that of the Mill Creek Valley sewer. At a meeting of the club to be held Nov. 24 Admiral H. R. Stanford, chief of the Bureau of Yards and Docks, U. S. N., will speak on "The Pearl Harbor Dry Dock."

Personal Notes

Jefferson D. Davis, formerly superintendent for the Foundation Company, and later for the Jarrett-Chambers Company, on the Hunt's Point Terminal work in New York City, has been appointed superintendent for the Jarrett-Chambers Company on the Bear River improvement in Bear Lake County, Idaho. Previous to his connection with the Hunt's Point work, Mr. Davis was engaged in the development of oil fields in the island of Trinidad. Before that he was with the Empire Engineering Corporation of New York City, as superintendent on New York State Barge Canal work and in a similar capacity on the construction of a 2300-ft. reinforced-concrete wharf at Port au Prince, Haiti.

E. L. Landorph, formerly resident engineer of District 2 of the Manitoba division of the Canadian Pacific Railway, has been appointed resident engineer of District 1 of that division, with office at Kenora, Ontario.

P. M. Lau, formerly chief draftsman and resident engineer of Division 2 for the State Highway Commission of California and city engineer of Dunsmuir, Cal., has been appointed chief engineer of the Detroit Construction Company of Detroit, to have charge of interurban railway construction. Mr. Lau first engaged in engineering work in 1907 on the forces of the San Diego & Arizona Railway Company of San Diego, Cal., after a 3-year course in civil engineering at the University of Minnesota. In 1909 he entered the service of the San Diego County Highway Commission. From this work he went to the Detroit, Lansing & Grand Rapids Railway of Detroit, as principal assistant engineer in 1910. In 1911 he returned to California and was appointed engineer on bridge and road construction for the San Joaquin County Highway Commission. He entered the service of the State Highway Commission in 1912.

James Townsend Taylor, consulting engineer, of Honolulu, Territory of Hawaii, has been appointed consulting engineer to the water investigating commission to make investigations and surveys of the available water supply for the city of Honolulu.

George J. Ray, chief engineer of the Delaware, Lackawanna & Western Railroad, received the honorary degree of Doctor of Science at Lafayette College, Oct. 20. Mr. Ray was graduated from the University of Illinois in 1898 and entered railway service as rodman on the Illinois Central in June of that year. He attained the grade of roadmaster of the Dubuque division, in charge of engineering, maintenance and construction, in this service previous to leaving it, in 1903, to become division engineer on the Delaware, Lackawanna & Western, at Scranton, Pa. He was appointed chief engineer of this road in 1909. Perhaps the most notable achievement of his administration has been the construction of the Nicholson cut-off and the Tunkhannock viaduct. Mr. Ray is a director of the American Railway Engineering Association, vice-chairman of the committee on track and a member of the special committee on stresses in track. He is also a member of the American Society of Civil Engineers.

Norman C. Smith, formerly draftsman for the Berlin Construction Company, fabricator of steel bridges, buildings, trusses and steel shapes, of Berlin, Conn., has been appointed draftsman for the McClintic-Marshall Company, manufacturer and erector of steel bridges and buidings, at its Rankin plant. Previous to his connection with the Berlin company, Mr. Smith was for a short time with the New York, New Haven & Hartford Railroad on the electrification work from New York City to Stamford, Conn.

J. L. Starkie has been appointed assistant engineer of the Atchison, Topeka & Santa Fé Railway, with headquarters at Galveston, Tex.

E. F. Ketter, formerly city engineer of Mexico, Mo., and county surveyor and highway engineer of Audrain County, Missouri, is now with the Atchison, Topeka & Santa Fé Railway on valuation work in the offices at Topeka, Kan. Mr. Ketter finished his work as city engineer and county surveyor in May of the present year. During the period intervening since then and his present appointment he was engaged as engineer on the construction of a 7-mile electric railway extension at Mexico, Mo. He was graduated from the University of Missouri in 1908.

R. T. Robinson, resident engineer on the Ohio River bridge for the Chesapeake & Ohio Railway at Sciotoville, Ohio, left that work upon the completion of the 27 piers for the structure last month and is now at Rankin, Pa., in charge of assembling the river span trusses for reaming as they leave the shops of the McClintic-Marshall Company, the fabricator. In the spring, Mr. Robinson will return to Sciotoville, where he will have charge of the erection of the superstructure.

Frank H. Constant, professor of civil engineering at Princeton University, received the honorary degree of Doctor of Science at Lafayette College, Oct. 20. He was graduated from the University of Cincinnati in 1891 and served as assistant engineer in the contracting and estimating department of the King Bridge Company of Cleveland, Ohio, from that time until 1893, when he was appointed assistant engineer in charge of the design of structural work for the Osborn Company, also of Cleveland. In 1895 he became assistant professor of structural engineering at the University of Minnesota. He continued in that position until 1897, when he was appointed professor of structural engineering at the same university. He left the University of Minnesota to become professor of civil engineering at Princeton in 1914.

Edgar M. Ledyard, University of California graduate, and formerly a teacher in the agricultural college in the Philippine Islands, has been appointed head of the agricultural staff of the United States Smelting, Mining & Refining Company, which has interests in California, Utah and South American countries. Mr. Ledyard's duties will be to give expert advice and adjust claims of farmers in the vicinity of the smelters whose property has been damaged by smoke fumes.

Ernest Owen, formerly designer and estimator with the Riverside Bridge Company of Martin's Ferry, Ohio, has been appointed structural designer for the Gulf Refining Company at Port Arthur, Tex. Mr. Owen was graduated from the University of Pennsylvania in 1913 and was with the Riverside Company from then until the present appointment.

Burns & McDonnell, consulting engineers, of Kansas City, have moved their offices from the Scarritt Building to the Interstate Building, Kansas City.

L. J. Hotchkiss, engineer for the Bates & Rogers Construction Company, has opened a contractors' consulting engineer's office in the Monadnock Building, Chicago. For 11 years he was with the Chicago, Burlington & Quincy Railroad Company, successively as detailer, designer, assistant engineer and finally as assistant bridge engineer in charge of all permanent construction east of the Missouri River. Previous to his 2-year engagement with Bates & Rogers he was with the Foundation Company for a year, during which time he had charge of the Scotia dam and the foundation work for the Morgan Building in New York City. Mr. Hotchkiss proposes, in addition to consulting work on heavy construction, on plant layouts and on temporary structures, to make quantity surveys and estimates for contractors.

H. C. Bushnell, formerly engineer on the staff of H. E. Molé, consulting engineer, of the New York City, has been appointed mechanical assistant to the superintendent of motive power of the United Railways & Electric Company of Baltimore.

F. G. Campbell, formerly resident engineer for the Chicago, Milwaukee & St. Paul Railway on the work at Oxford Junction, Kan., is now engaged in valuation work for the same company at Chicago.

Blake Taylor, formerly special district engineer of Grant District, Wetzel County, West Virginia and, more recently, in charge of street improvements at Berkely Springs, W. Va., has been appointed chief engineer of road construction under the $550,000 bond issue in Wyoming County, West Virginia. The work of location and design is already well under way and several miles of road will be ready for contract and construction in the early spring. The entire sum available will be used for bridges and grading purposes, and the question of metalling the main roads will probably be considered in a subsequent bond issue.

Thornton W. Price, formerly designing engineer with the American Bridge Company and for the past two years in charge of a large part of the work on the Panama Canal Coaling Stations, has opened offices in the Woolworth Building, New York City, for the practice of structural and mechanical engineering. Mr. Price is a graduate of the University of Pennsylvania and was five years in the employ of the American Bridge Company, three of them previous to his college course and two after graduation. His work on the Panama coaling stations was done while with the Bergen Point Iron Works of Bayonne, N. J., with which company he was connected for two years.

Fred W. Claflin, formerly resident engineer and superintendent of construction for the Cambria Steel Company of Johnstown, Pa., on its Quemahoning dam and pipe line, has been appointed assistant engineer of grade elimination for the New York, Chicago & St. Louis Railroad at Cleveland, Ohio. He was graduated from Massachusetts Institute of Technology in 1901 and served until 1905 with the division engineer of the Boston & Albany Railroad on grade separation, roundhouse additions, the construction of reinforced-concrete arch bridge over Cook's Creek at East Chatham, N. Y., and other works. In 1905 he was with the signal engineer of the Lake Shore & Michigan Southern, and, in the fall of the year, was traveling engineer, estimator and inspector of coal mines for F. C. Greene, mining engineer, of Cleveland, Ohio. He became connected with the Cambria Steel Company in 1906.

R. E. Anthony, formerly civil engineer for the Mountain Slater Supply Company of Philadelphia, has been appointed transitman on the plant enlargement work of the Pennsylvania Steel Company at Steelton, Pa.

T. Kitazawo, professor of structural engineering at Nagoya Technological College, Nagoya, Japan, is in this country by order of the Department of Education of the Imperial Japanese Government to study bridge constructions.

Clifton E. Visel has been appointed chief engineer of the mining department of the Montezuma Copper Company at Pilares de Nacozari, Sonora, Mexico. He was graduated from Sheffield Scientific School, Yale University, in 1908.

E. C. Meyer, civil engineer with the Trussed Concrete Steel Company, has been transferred from the company's Detroit office to the office at Youngstown, Ohio.

Frank N. Wilmot, formerly connected with the Casper Ranger Construction Company of Holyoke, Mass., has been appointed to have charge of the concrete work on the new municipal cotton warehouses being constructed at New Orleans.

John A. Crowley, formerly assistant engineer of construction with the Interborough Rapid Transit Company of New York City, has been appointed to a similar position with the New York Central & Hudson River Railroad.

George Bronson Rea, an American, editor of the *Far Eastern Review*, has been awarded the grand prize offered by the Chinese Government for the best program for a National system of railways. Schemes were submitted, it is stated, by British, French, German, Japanese and Chinese engineers, and Chinese Government officials have spent two years studying and comparing the plans. While the details of Mr. Rea's program have not been made public, it is understood that they call for the construction of twenty trunk lines, aggregating 11,000 miles.

Civil Service Examinations

United States.—An unassembled examination for a pulp and paper engineer, salary $3,500 a year, in connection with the Forest Service at its laboratory in Madison, Wis., will be held on Dec. 14. The duties of the position will be to direct the work of the pulp and paper investigations of the service. Applicants must be 30 years of age and must have had eight years' experience in the pulp and paper industry, or four years in laboratory research work. They should be, besides, familiar with the technical problems of the industry and with investigative work. Application blanks are to be filed, properly executed, at Washington, D. C., on or before Dec. 14.

Two other examinations for marine-engine and boiler draftsman and marine-engine draftsman for submarines, salaries from $4 to $5.04 a day each, in conjunction with the machinery division of the United States Navy Yard, New York, and the Inspector of Machinery, Quincy, Mass., and Busch-Sulzer Company, St. Louis, are to be held on Dec. 8 and 9 and Dec. 21 respectively. The duties relative to these positions are strictly technical, familiarity with steam turbines and gas and oil engines being requisite. Technical training, and drafting experience of from two to four years are likewise essential. The forms for application must be on file on the dates of the examinations.

In making applicaton for any one of the above positions candidates should address the United States Civil Service Commission at Washington, D. C., or one of the civil service boards in the principal cities, specifying for the position of pulp and paper engineer, form 2118; marine-engine and boiler draftsman, form 1312, and marine-engine draftsman for submarines, form 304.

Philadelphia.—The Civil Service Commission announces examinations for the following positions open to residents of the city, to be held on the days specified.

Assistant Engineer, testing laboratory, Surveys Bureau, Public Works, salary $3,000 a year, to be held Dec. 10 and 13.

Assistant Engineer, abolishment of grade crossings, Surveys Bureau, salary $2,500 a year, 25 years of age, to be held Jan. 13 and 14, 1916.

Draftsman, bridge division, Surveys Bureau, salary $1,200 a year, to be held Jan. 17 and 18, 1916.

Besides these examinations there are several others for minor positions, information for which may be secured by applying to the Civil Service Commission, Room 875, City Hall, Philadelphia.

Illinois.—Following the announcement published in the Engineering Record of last week, page 615, comes the report that the unassembled examination for waterways engineer, salary from $150 to $250 a month, open to non-residents, will be held Dec. 4, application forms to be on file in Springfield, Ill., on or before Saturday, Nov. 27. The duties of the position involve land surveying, supervision of waterways, dams and levees, and report writing. Applicants must be 25 years of age.

International Trade Conference to be Held Dec. 6-8

An international trade conference to commemorate twenty years of practical service to manufacturers has been arranged for by the foreign trade department of the National Association of Manufacturers, to be held at the Hotel Astor, New York City, Dec. 6-8. Papers will be presented by authorities on the several subjects and it is expected delegates from a number of foreign chambers of commerce and banks will take part in the discussions.

Business Notes

M. C. McNeil, formerly connected with the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company, has been engaged by the Osgood Company, manufacturer of steam shovels, dredges and other equipment, of Marion, Ohio, to take charge of sales.

The Cleveland Galvanizing Works Company, manufacturer of weldless wire chain and chain products, of Cleveland, Ohio, has acquired nineteen parcels of land—a city block—adjacent to its present location, which will permit it to greatly enlarge its present plant and output as soon as certain leases expire. The property has a railroad siding and fronts on four streets.

The Clark Book Company, Inc., publisher of technical books, a new corporation, with offices at 27 William Street, New York City, has taken over the entire book business—copyrights, plates, sheets and bound copies—of the Myron C. Clark Publishing Company of 608 South Dearborn Street, Chicago, and will handle all books heretofore published by the latter company, together with some others.

The Canton Culvert & Silo Company, Canton, Ohio, has just published a set of specifications for corrugated metal culverts. These have been prepared with a view to co-operating with railway and highway engineers, contractors and others, in supplying them, for reference at least if not for adoption, a foundation for a comprehensive specification for culverts. The specifications are not limited to any single type, riveted or nestable, but rather present a choice of all that the company considers fair and good in the production of a first-class culvert. The various sections embody the experience gained by the company in studying metal culverts. One of the sections covers the analytical features which call for a pure iron, but the company explains that this may be omitted and the remaining clauses cover the best type of culvert construction.

Trade Publications

Raymond W. Dull Company, Chicago. Catalog, 6¾ x 10 in., 80 pages, illustrated. Contains a complete line of sand and gravel plant equipment—screens, elevators, buckets, cableways, etc.

James B. Clow & Sons, Chicago. Catalog, 9¼ x 12 in., 54 pages, illustrated. Covers primarily plumbing fixtures for industrial establishments; describes also cast-iron pipe, faucets, valves and public works fixtures.

Weller Manufacturing Company, Chicago. General catalog 20, cloth, 6 x 9½ in., 560 pages, illustrated. Complete in its subject of elevating, conveying and power transmitting machinery. Clutches, pulleys, transmission belting, elevators, conveyors, buckets, spouters, gears, chains, sprocket wheels, etc., are each treated separately, with complete description and information as to sizes, make, class, price, etc. There is appended as well useful information of the nature of mensuration and conversion tables, and also an alphabetical index covering the entire edition. The value of this catalog to the engineer and contractor lies in its completeness of efficient labor-saving hauling machinery, which should make it a necessary and profitable addition to their files.